30676

NATIONAL LIBRARY
OTTAWA

CANADA

BIBLIOTHÈQUE NATIONALE
OTTAWA

NAME OF AUTHOR...THOMAS...H...FLETCHER

TITLE OF THESIS..MANAGEMENT..ALTERNATIVES
IN...RESIDENTIAL..WATER..SUPPLY:
PERCEPTION..AND..CHOICE..IN..ALBERTA.

UNIVERSITY..OF..ALBERTA.............................

DEGREE FOR WHICH THESIS WAS PRESENTED..MASTER..OF...ARTS.

YEAR THIS DEGREE GRANTED...1976.......................

Permission is hereby granted to THE NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

(Signed)..........

PERMANENT ADDRESS:

8515-94..AVE.......
FORT..SASKATCHEWAN
ALBERTA............

DATED..JULY....15....1976

NL-91 (10-68)

INFORMATION TO USERS

THIS DISSERTATION HAS BEEN MICROFILMED EXACTLY AS RECEIVED

This copy was produced from a microfiche copy of the original document. The quality of the copy is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

PLEASE NOTE: Some pages may have indistinct print. Filmed as received.

Canadian Theses Division
Cataloguing Branch
National Library of Canada
Ottawa, Canada K1A 0N4

AVIS AUX USAGERS

LA THESE A ETE MICROFILMEE TELLE QUE NOUS L'AVONS RECUE

Cette copie a été faite à partir d'une microfiche du document original. La qualité de la copie dépend grandement de la qualité de la thèse soumise pour le microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

NOTA BENE: La qualité d'impression de certaines pages peut laisser à désirer. Microfilmee telle que nous l'avons reçue.

Division des thèses canadiennes
Direction du catalogage
Bibliothèque nationale du Canada
Ottawa, Canada K1A 0N4

THE UNIVERSITY OF ALBERTA

MANAGEMENT ALTERNATIVES IN RESIDENTIAL WATER SUPPLY: PERCEPTION AND CHOICE IN ALBERTA

by

© Thomas H. Fletcher

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF ARTS

DEPARTMENT OF GEOGRAPHY

EDMONTON, ALBERTA
FALL, 1976

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Management Alternatives in Residential Water Supply: Perception and Choice in Alberta submitted by Thomas H. Fletcher in partial fulfilment of the requirements for the degree of Master of Arts.

Arleigh H. Laycock
Supervisor

Smith

T. S. Freeman

Date June 28, 1976

Abstract

When faced with water shortages, residential water managers may choose from two basic categories of solutions: (1) "management alternatives" such as pricing, metering, and rationing; and (2) "construction oriented solutions" such as building pipelines to new sources or constructing new water treatment plants. Due to managerial perceptions and attitudes, the construction oriented solutions are usually chosen.

The objectives pursued in this thesis were three-fold: (1) to document the residential water supply and demand characteristics in Alberta; (2) to document the perception and attitudes of residential water managers in Alberta toward management alternatives; and (3) to explore the relationships between the perceptions and attitudes of the water managers and the experience of these water managers with both water supply/demand problems and with the use of management alternatives.

The data used in the research project were obtained primarily through a postal questionnaire. This questionnaire was sent to all municipalities in Alberta with public water supply systems during the summer of 1973. A response rate of 72 percent was achieved, representing 95 percent of all Albertans living in urban communities.

Analysis of the data revealed that per capita demands for residential water have been increasing in Alberta. Demand levels were subject to significant regional

variations which were the result in part of climatic variations throughout the province. The levels of per capita demand were also affected significantly by the use of management alternatives such as metering.

Management alternatives, however, were not found to be effectively utilized in the province. Generally, it might be said that the ineffective use of these alternatives stemmed from unfavourable perceptions of the alternatives by water managers. At the same time, water managers did not appear to be fully aware of the implications or potential effectiveness of management alternatives.

It is argued within the thesis that of all Canadian provinces, Alberta is potentially the first one which may suffer economically if scarce water resources are not used efficiently. The evaluation of management alternatives as part of the solutions to increasing water demands is a necessary part of the efficient use of these water supplies.

TABLE OF CONTENTS

CHAPTER PAGE

1. INTRODUCTION 1
   - Efficiency in Residential Water Use 2
   - General Objectives and Format 3
   - The Study Area 4
2. BEHAVIOURAL STUDIES IN GEOGRAPHY 10
   - Theoretical and Practical Beginnings 11
   - Perceptions, Attitudes, Behaviour 14
     - Perceptions 14
     - Attitudes 15
     - Perceptions, Attitudes, Behaviour 17
   - Why Study Perceptions and Attitudes in Resource Management 19
     - Decision Making and Policy Formulation 19
     - Perception Studies in Resource Management 20
     - Why Study Perceptions and Attitudes of Residential Water Managers in Alberta 24
   - Summary 26
3. MANAGEMENT ALTERNATIVES IN RESIDENTIAL WATER SUPPLY 32
   - Residential Water Use: The Need for Efficiency 33
   - Efficiency in Residential Water Management 37
   - Characteristics of Residential Water Supply and Demand. . 40
     - Temporal Variations in Demand 41
     - General Increases in Demand 41
     - Spatial Variations in Demand 42
   - Pricing and Metering 44
     - Objectives in Pricing and Metering 44

CHAPTER PAGE

Types of Pricing 46
Metering 49
Effectiveness of Pricing and Metering 50
Rationing 56
Types 56
When Is Rationing Desirable? 56
Effectiveness in Rationing 57
Leakage 58
The Use of Management Alternatives in Alberta 59
Summary 62
4. OBJECTIVES AND RESEARCH METHODOLOGY 68
Specific Objectives 68
Research Methodology 70
Methodology Approach 70
The Sample 71
Administration of the Questionnaire 72
Measurement of Attitudes 76
The Questionnaire 77
Statistical Analysis 79
5. CHARACTERISTICS OF WATER SUPPLY AND DEMAND IN ALBERTA 82
Water Supply 82
Sources 82
Water Quality 86
Shortages 87
Water Supply and Sewerage 90
Expansions 94
Leakage 95
Profit and Loss 96

CHAPTER PAGE

Water Demand 97
  Per Capita Demand 97
  Increases in Demand 101
  Peak Demands 104
  Regional Variations in Demand 110
  Demand Projections 111
Metering 112
  Extent of Metering 112
  Impact of Metering 112
Pricing 116
  Types of Pricing Schedules 116
  Structure of Schedules 119
  Price 122
  Impact of Different Schedule and Pricing Policies 124
Rationing 128
  Extent of Use 128
  Implementation 132
Summary 132
6. PERCEPTIONS, ATTITUDES, AND MANAGEMENT ALTERNATIVES . . . 137
General Attitudes Toward Water Supply 138
Perceptions, Attitudes, and Water Conservation 139
Perceptions, Attitudes, and the Use of Management Alternatives . . . 142
  Metering 142
  Pricing 143
  Rationing 151

CHAPTER PAGE

What The Public Expects 160

Summary 162

7. EXPERIENCE, PERCEPTIONS, ATTITUDES, BEHAVIOUR 165

Introduction 165

Metering 166

Schedule Type 167

Past Shortages and Rationing 173

Past Expansions 181

Summary 185

8. SUMMARY AND CONCLUSIONS 187

***

APPENDIX A. QUESTIONNAIRE ON RESIDENTIAL WATER IN ALBERTA 200

APPENDIX B. COMMUNITIES WHICH HAVE SUFFERED SHORTAGES IN THE PAST FIVE YEARS 225

APPENDIX C. COMMUNITIES WHICH HAVE RATIONED RESIDENTIAL WATER SINCE JANUARY, 1969 226

LIST OF TABLES

Table	Description	Page
3-1	Demand Rates for Medium and High Value Homes	43
3-2	Current Pricing Policies of Water Utilities	46
3-3	Metered and Unmetered Residential Water Use, West United States	52
4-1	Response Rates to Pilot Questionnaire	74
4-2	Response Rates to final Questionnaire	75
5-1	Sources of Water Supply for Alberta Communities	83
5-2	Number of Albertans Dependent Upon Various Sources of Water, 1972	84
5-3	Population of Alberta Communities by Source of Water Supply, 1972	85
5-4	Number of Alberta Communities in Each River Basin by Source of Water Supply	85
5-5	Water Managers' Perception of Their Communities' Quality of Water Supply in Alberta	86
5-6	Water Managers' Perception of the Quality of the Water Supply by Source in Alberta Communities	87
5-7	Water Managers' Perception of the Quality of Water Supply by River Basins in Alberta	87
5-8	Factors Causing Water Shortages in Alberta Communities	88
5-9	Factors Predicted to cause Future Water Shortages in Alberta	89
5-10	Percentage Distribution of Alberta Communities by Amount of Maximum Capacity Used on Peak Days	90
5-11	Frequency of Water Shortages by River Basins in Alberta	92
5-12	Status of Alberta Municipalities by Relationship Between Water and Sewage Departments	93

Table	Description	Page
5-13	Municipal Status of Alberta Communities Which have Undertaken Expansions	94
5-14	Percentage of Total Water Supplied Which is Lost Through Leakage in Alberta Communities, 1972	96
5-15	Percentage Distribution of Alberta Communities by Amount of Profit or Loss Shown by Their Water Supply Utilities, 1972	97
5-16	Percentage Distribution of Alberta Communities by Per Capita Consumption Per Day	98
5-17	Percentage of Total Municipal Pumpage Sold To Large Water Using Industries in Alberta	100
5-18	Average Per Capita Consumption Per Day in Alberta in 1972, Without the Effects of Industry, by Status of Community	101
5-19	Percent of Alberta Communities Showing Increases or Decreases in Annual Consumption	102
5-20	Percent of Alberta Communities Showing Increases or Decreases in Average Annual Per Capita Consumption	103
5-21	Population of Alberta Communities by Per Capita Increases or Decreases in Consumption, 1966 to 1972	104
5-22	Peak Month Consumption in Alberta Communities as a Percent of Average and Lowest Months of Consumption, 1972	106
5-23	Number and Percent of Alberta Communities Having Maximum Consumption in Each Month, 1971, 1972	107
5-24	Peak Day Per Capita Consumption in Alberta Communities as a Percent of Average Per Capita Consumption	108
5-25	Number of Communities in Each River Basin in Alberta, Classified According to Peak Month Consumption as a Percent of Average Monthly Consumption, 1972	109
5-26	Number of Communities in each River Basin in Alberta, Classified According to Peak Month Consumption as a Percent of Lowest Month Consumption, 1972	109

Table	Description	Page
5-27	Average Per Capita Consumption Per Day, 1972, By River Basins in Alberta	110
5-28	Alberta Communities Which Have Made Demand Projections by Municipal Status, 1973	111
5-29	Extent to Which Metering is Employed in Alberta Communities, 1973	112
5-30	Relationship Between Extent of Customer Metering and the Metering of Pumps in Alberta Communities, 1973	113
5-31	Population of Alberta Communities by Metering of Residential Customers, 1973	113
5-32	Impact of Residential Metering in Alberta on Average Per Capita Consumption Per Day, Without the Effects of Industry, 1972	114
5-33	Impact of Residential Metering in Alberta on Amount of Average Monthly Water Bill, 1972	115
5-34	Impact of Residential Metering on Profits and Losses of Water Utilities in Alberta, 1972	116
5-35	Types of Pricing Schedules Used in Alberta, 1973	117
5-36	Population of Communities in Alberta by Type of Pricing Schedule, 1973	118
5-37	Frequency of Use of Different Schedule Types by River Basins in Alberta, 1973	118
5-38	Status of Alberta Municipalities by Number of Blocks in Water Pricing Schedule, 1973	120
5-39	Sizes of First Block in Water Pricing Schedules Used in Alberta Communities, 1973	121
5-40	Sizes of Units in the second Block of Water Pricing Schedules Used in Alberta Communities, 1973	122
5-41	Average Costs of Various Sized Units in Second Block of Water Pricing Schedules Used in Alberta Communities, 1973	123

Table	Description	Page
5-42	Percentage Distribution of Average Amounts of Water Bills in Alberta Communities with Different Means of Charging for Sewerage Services, 1973	123
5-43	Pricing Schedule Type by Average Monthly Water Bill in Alberta Communities, 1973	125
5-44	Frequency of pricing Schedule Type in Alberta Communities by Whether Or Not The Utility Shows a Profit or Loss, 1972	125
5-45	Pricing Schedule Type by Average Per Capita Consumption Per Day in Alberta Communities, 1972	126
5-46	Pricing Schedule Type by Average Per Capita Consumption Per Day in Alberta Communities, Without the Effects of Industry, 1972	127
5-47	Pricing Schedule Type by Peak Month Consumption as a Percent of Lowest Month Consumption in Alberta Communities, 1972	127
5-48	Frequency of Municipal Status by Rationing in Alberta Communities	130
5-49	Frequency of Rationing by Percent of Maximum Capacity Used on Peak Days in Alberta Communities, 1972	130
5-50	Number of Alberta Communities in Each River Basin Which Have Rationed Water	131
5-51	Tabular Summary of Areas of Significance in Analysis of Supply and Demand Characteristics in Alberta Communities	134
6-1	Priority Given to the Provision of Residential Water in Alberta Communities (When Competing for Funds With Such Things as Roads, Parks, and Recreational Facilities)	139
6-2	Distribution of responses to the Question: "Would You Agree Or Disagree That It Is Right To Restrict A Person's Consumption Of Water?".	139
6-3	Distribution of Responses to the Statement: "Using As Little Water As Possible Is a Worthwhile Goal For Any Water Department"	140

Table Description Page

6-4 Distribution of Responses to the Statement: "There Is No Need To Conserve Water, At Least In Alberta, Because There Is Plenty Of Water For Everybody" 141

6-5 Cross Tabulation of Responses to the Question: "Is It Right To Restrict Consumption?" By Responses to the Statement "There Is No Need To Conserve Water, At Least in Alberta" 141

6-6 Frequency of Responses to Statements Related to the Perceived Benefits of Residential Water Conservation 142

6-7 Distribution of Responses to the Question: "How Effective Do You Feel Meters Would Be In Reducing Consumption, Particularly After They Have Just Been Installed?" 143

6-8 Distribution of Responses to the Question: "If The Consumption Of Water Per Household Was Reduced By Metering Initially, Do You Feel It Would Return To Normal After The Meters Had Been Installed A Year Or Two?" 144

6-9 Distribution of Responses to the Question: "What Would You Say Is The Best 'Rule Of Thumb' On Which To Base The Price Of Water?" 146

6-10 Explanations for the Use of Particular Pricing Schedules in Alberta 146

6-11 Distribution of Responses to the Question: "If A Community Already Had Metering, How Effective Do You Feel Raising The Price Of The Water Would Be In Reducing Demand?" 147

6-12 Distribution of Responses to the Question: "How Would You Judge The Ability Of Your Community To Pay, Through Higher Water Rates, For An Expanded Water Supply System?" 147

6-13 Distribution of Responses to the Statement: "Everyone Should Be Allowed a Certain Minimum Quantity Of Water To Cover Basic Needs And People Who Use More Than That Should Pay More For Each Unit Of Water Above That Minimum" . . . 149

6-13 Distribution of Responses to the Statement: "Most People Would Be Quite Willing To Pay More For Extra Units Of Water If They Had To" 149

Table	Description	Page
6-15	Cross Tabulation of Managers' Perceptions of People's Willingness to Pay by Perceptions of Their Ability to Pay	151
6-16	Perception of the Implications of Conservation Pricing Schedules	151
6-17	Perception by Alberta Water Managers of Whether Or Not It Is Right To Restrict the Consumption of Residential Water by Their Perception of Whether Or Not People Who Use More Than A Basic Minimum Quantity Of Water Should Pay More	152
6-18	Perception By Alberta Water Managers Of Whether Or Not It Is Right To Restrict Consumption By Whether Or Not People Should Pay More For Water Used To Wash Their Car(s)	152
6-19	Perception by Alberta Water Managers Of Whether Or Not It Is Right To Restrict Consumption By Whether Or Not People Should Pay More For Water Used To Fill Their Swimming Pools	153
6-20	Distribution Of Responses To The Question: "How Effective Would You Consider Rationing To Be As A Means of Reducing Consumption?"	153
6-21	Perception Of Rationing As An Acceptable Means Of Reducing Consumption	154
6-22	Perception Of Efficiency With Which Residential Consumers Use Water	155
6-23	Managers' Perceptions Of How Much Water People Should Be Supplied With	156
6-24	Perception By Alberta Water Managers Of Whether It Is Right To Restrict Consumption By Whether Or Not It Is Best To Supply All the Water Demanded By People	157
6-25	Perception By Alberta Water Managers Of Whether It Is Right To Restrict Consumption By Whether Or Not People Have A Right To All The Water They Want	157
6-26	Perception Of Whether It Is Right To Restrict Consumption By Whether Or Not People Should Only Be Allowed So Much Water For Lawn Irrigation	158

Table	Description	Page
6-27	Perception Of Whether It Is Right To Restrict Consumption By Whether Or Not Short Term Rationing Is An Acceptable Means Of Reducing Consumption	158
6-28	Perception Of Whether It Is Best To Supply All The Water Demanded By Perception Of Community's Ability To Pay For An Expanded System	159
6-29	Managers' Perceptions Of What The Public Expects In Terms Of Water Supply	160
6-30	Managers' Perceptions Of What The Public Expects To Pay For Water	161
6-31	Distribution Of Responses To The Statement: "The Public Expects The Water Department To Encourage The Conservation Of Water"	162
7-1	Experience Of Residential Water Managers With Metering By Their Responses To The Statement: "There Is No Need To Conserve Water, At Least In Alberta Because There Is Plenty Of Water For Everybody"	166
7-2	Experience Of Residential Water Managers With Metering By Their Responses To The Statement: "If You Could Reduce The Consumption Of Water Per Household, You Could Reduce The Costs Of Supplying The Water"	167
7-3	Experience Of Residential Water Managers With Metering By Their Responses To the Statement: "The Public Expects The Water Department To Encourage The Conservation Of Water"	167
7-4	Experience of Residential Water Managers With Metering By Their Responses To The Statement: "Generally, It Might Be Said That Most People Do Not Waste Water"	168
7-5	Experience Of Residential Water Managers With Metering By Their Responses To The Statement: "It Is Unlikely That Most People Overuse Water In And Around Their Homes"	168
7-6	Experience Of Residential Water Managers With Metering By Their Responses To The Statement: "People Should Pay More For Water Used To Fill Their Swimming Pools"	169

Table	Description	Page
7-7	Experience Of Residential Water Managers With Metering By Their Responses To The Statement: "People Should Pay More For Water Which They Use To Irrigate Their Lawns"	169
7-8	Experience Of Residential Water Managers With Metering By The Manner In Which The Effect Of Price Increases On Reducing Demand Is Perceived	170
7-9	Experience Of Water Managers With Different Pricing Schedules By Their Responses To The Statement: "Everyone Should Be Allowed A Certain Standard Minimum Quantity Of Water To Cover Basic Needs And People Who Use More Than That Should Pay More For Each Unit Of Water Above That Minimum"	171
7-10	Experience Of Water Managers With Different Pricing Schedules By Their Perception Of The Effectiveness Of Price Increases In Reducing Demand	172
7-11	Experience Of Water Managers With Different Pricing Schedules By The Perceived Effect Of Prices In Keeping Consumption Levels Down In The Long Run.	172
7-12	Experience Of Water Managers With Different Pricing Schedules By The Perceived Effect Of Metering In Keeping Consumption Levels Down In The Long Run	173
7-13	Experience Of Water Managers With Different Pricing Schedules By Their Responses To The Statement: "The Public Expects The Water Department To Encourage The Conservation Of Water"	174
7-14	Experience Of Water Managers With The Occurrence Of Water Shortages By Their Responses To The Statement: "Generally, It Might Be Said That Most People Do Not Waste Water"	174
7-15	Experience Of Water Managers With the Occurrence Of Water Shortages By Their Responses To The Statement: "If You Could Reduce The Consumption Of Water Per Households, You Could Reduce the Costs of Supplying The Water".	175

Table	Description	Page
7-16	Experience Of Water Managers With Rationing By Their Perception Of Its Acceptability For Short Periods of Use	176
7-17	Location Of Water Managers According To River basins By Their Perception Of Rationing As Acceptable For Long Periods Of Use	177
7-18	Experience Of Water Managers With Rationing By Their Responses To The Statement: "Generally, It Might Be Said That Most People Do Not Waste Water"	177
7-19	Experience Of Water Managers With Rationing By Their Responses To The Statement: "It Is Unlikely That Most People Overuse Water In And Around Their Homes"	178
7-20	Experience Of Water Managers With Rationing By Their Perceived Effect Of Price In Keeping Consumption Down In The Long Run	179
7-21	The Use Of Rationing In Municipalities By Whether Or Not Expansions Have Been Undertaken	179
7-22	The Use Of Rationing In Municipalities By Whether Or Not There Are Plans For Future Expansions	180
7-23	The Use of Rationing In Municipalities By Their Use Of Engineering Consultants	180
7-24	The Use of Rationing In Municipalities By Whether Or Not Demand Projections Have Been Completed	181
7-25	Experience Of Water Managers With Past Expansions By Their Responses To The Statement: "Using As Little Water As Possible Is A Worthwhile Goal For Any Water Department"	182
7-26	Experience Of Water Managers With Past Expansions By Their Responses To The Statement: "If You Could Reduce The Consumption Of Water, You Could Reduce Sewage Treatment Costs Significantly	182

Table	Description	Page
7-27	Experience Of Water Managers With Past Expansions By Their Responses to the Statement: "Even If They Are Willing To Pay More, People Should Only Be Allowed To Use A Certain Amount Of Water To Irrigate Their Lawns"	183
7-28	Experience of Water Managers With Past Expansions By Their Perception Of The Ability Of The Community To Pay For Expansions	184
7-29	Cross Tabulation Of Communities Which Have Undertaken Expansions By Those Which Have Increased Price	184
7-30	Cross Tabulation of Communities Which Have Undertaken Expansions By The Amount Of The Monthly Waterbill In Those Communities	185

LIST OF FIGURES

Figure	Title	Page
3-1	Pricing at Marginal Cost	39
3-2	Reduction of Consumption Through Metering	53
3-3	Effects of Metering Over Time	54

LIST OF MAPS

Map	Title	Page
1-1	Mean Annual Precipitation in Alberta	5
1-2	Average Moisture Deficiency in Alberta	6
1-3	River Basins in Alberta	7
5-1	Spatial Distribution of Residential Water Shortages, Alberta, 1968 - 1972	91
5-2	Spatial Distribution of Communities Reporting Rationing, Alberta, 1968 - 1972	129

CHAPTER 1

INTRODUCTION

Historically, the supply of municipal water has been synonymous with the construction of water supply and treatment facilities, and often with massive engineering projects which are required to gain access to sufficient supplies. The costs of supply are often prohibitive, particularly in that the construction is usually of a single-purpose nature, and the costs compete for tax dollars which may be sorely needed for other programs. Moreover, the increasing costs of water supply stem not only from increases in aggregate demand, but also from per capita increases in demand.

The basic concern in this thesis is with the problem of meeting the increasing demand for residential water through the more efficient use of present supplies. The problem of using residential water more efficiently is part of an overall problem of resource management which has been the subject of increasing concern in the past decade - that of the effects of uncontrolled demand upon resources.

As O'Riordan[1] notes, the concern with efficiency in resource use has involved attempts to investigate the demand function for various resources, to relate the costs of resource use more closely to the beneficiaries of that use, and to develop a number of technological and managerial alternatives which might be used to improve the manner of use. Generally speaking, the objective in these attempts to improve the manner of resource use is to improve the efficiency of use, in which case the output of the resource is maximized yet the throughput (or wastage) per unit of resource consumed is minimized. Moreover, O'Riordan[2] suggests that perhaps the most serious questions which have been raised concern the manner in which demand projections for future resource use have been calculated, particularly regarding the assumptions upon which demand behavior is predicted. In the past, little consideration has been directed towards the possibility of changing demand; rather, the approach has been one of fitting the supplies to the demand.

EFFICIENCY IN RESIDENTIAL WATER USE

Perhaps there is no area within the field of resource management where the "fitting of supplies to demand" is more evident than in the provision of water for residential use. When faced with an imminent shortage of water, the "water manager" has two categories of solutions from which he may choose alternatives with which to meet demand and prevent shortages. The first category consists of "construction oriented alternatives" to increase the supply of water, such as the installation of more pumps, the digging of new wells, the building of pipelines to new and distant sources, and the construction of new water treatment plants. The second category of solutions is that of "management alternatives", such as metering and pricing policies to reduce the demand for water, and legislative action to restrict the consumption of water. While the optimum solution to most residential water supply problems would often involve a combination of these two categories of alternatives, the second category is rarely employed. Rather, the decision invariably provides for the construction of new water supply facilities.

Consequently, although management alternatives have been proven effective in reducing the demand for water, they have rarely been incorporated effectively into a residential water management program. The general consensus among most students of resource management is that the use of such alternatives is impeded by managerial, social, and political considerations[3].

GENERAL OBJECTIVES AND FORMAT

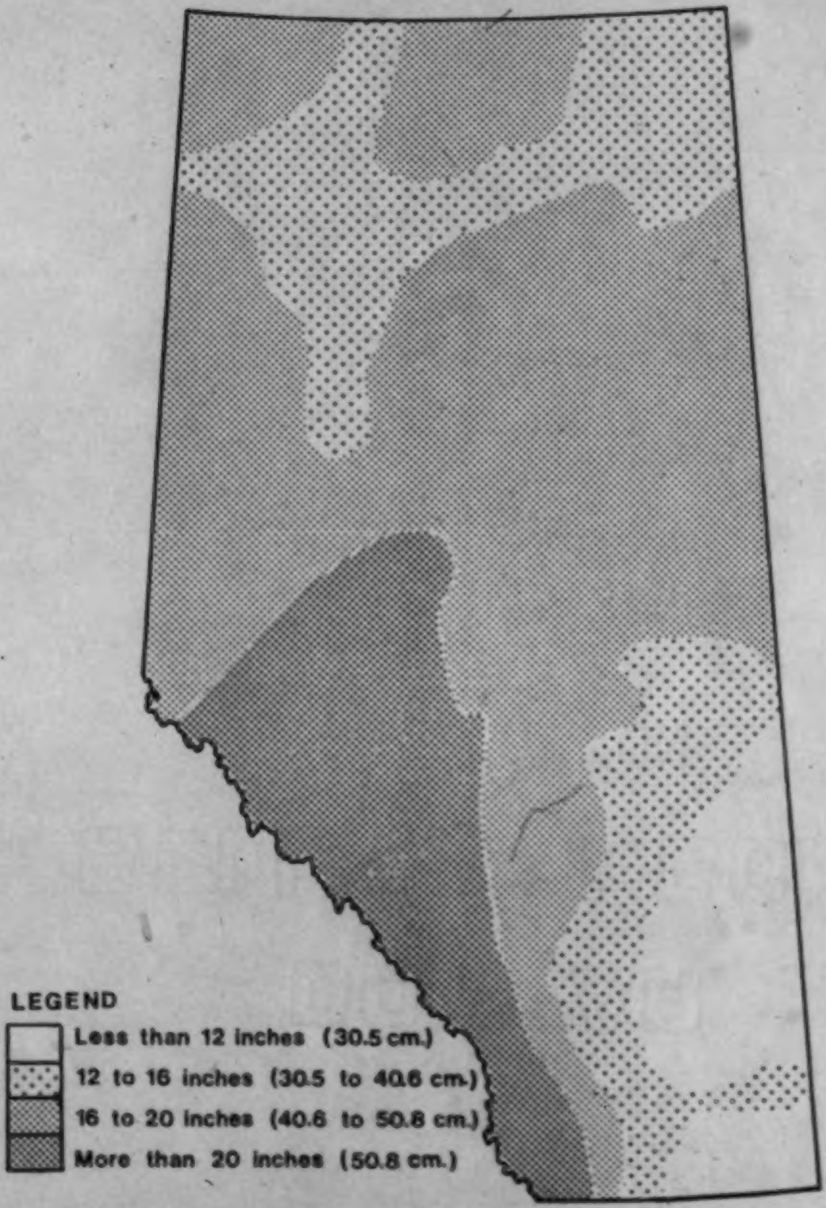
Implicit in the above discussion is the argument that impediments to the use of management alternatives stem from three general areas: managerial, social, and political. The general objective in this thesis is to determine the implications of managerial considerations to the use of management alternatives. More specifically, the research project is a behavioral study in which, using Alberta as a study area, the role of the water manager is examined in terms of the behavioural constraints which affect the perception of, choice of, and use of management alternatives in residential water supply.

The scope of the research in the thesis is defined only very broadly in the above paragraph. The specific objectives of the research project were drawn from the literature concerned with the problems and usefulness of perception and attitude studies in resource management. The objectives were also drawn from the assumptions upon which the use of management alternatives in residential water supply are based.

The objectives were further limited by the present state of knowledge on residential water supply and demand in Alberta. Consequently, the rationale behind the specific objectives will be more obvious following the discussion of the above three areas, and will therefore follow that discussion. The review of the above three areas and the statement of objectives will be followed by a review of the research methodology, the data analysis, and conclusions. Prior to undertaking the literature review, it is deemed appropriate to consider the propriety of using Alberta as a study area for problems related to residential water.

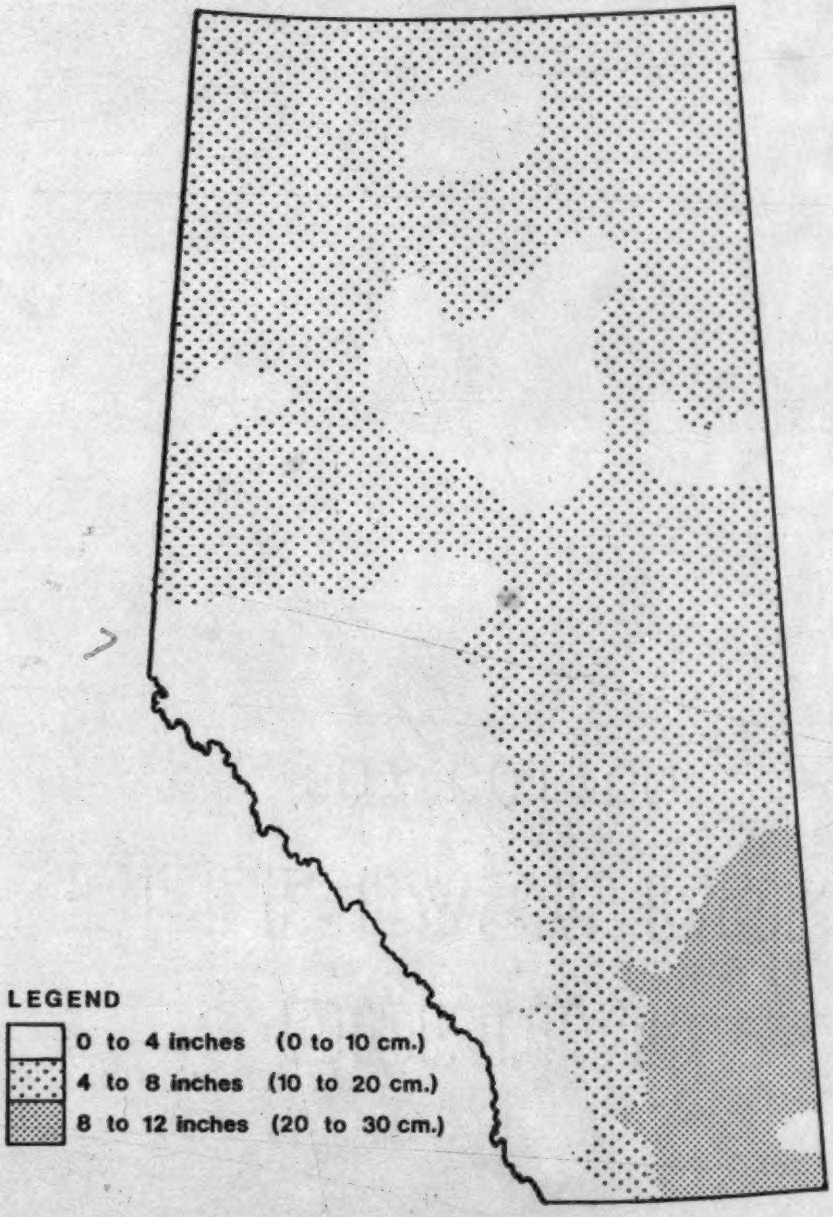
THE STUDY AREA

As is the case for all of Canada's Prairie Provinces, studies related to the efficient use of water are particularly relevant to Alberta; for, as in Saskatchewan and Manitoba, the plains of Alberta are moisture deficient.


LEGEND
Less than 12 inches (30.5 cm.)
12 to 16 inches (30.5 to 40.6 cm.)
16 to 20 inches (40.6 to 50.8 cm.)
More than 20 inches (50.8 cm.)

Source: Atlas of Alberta,
Government of Alberta
and The University of
Alberta, 1969, page 16.

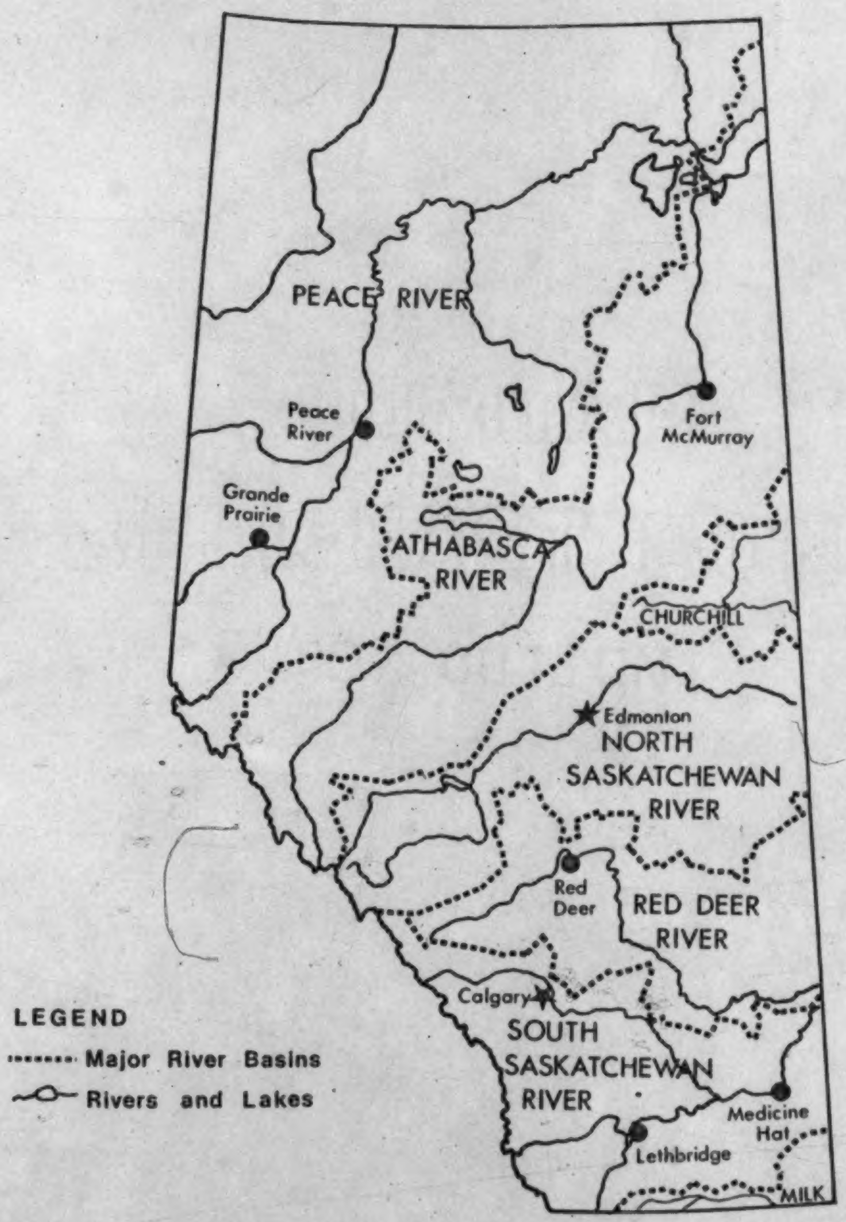
Map 1-1 Mean Annual Precipitation in Alberta


LEGEND
0 to 4 inches (0 to 10 cm.)
4 to 8 inches (10 to 20 cm.)
8 to 12 inches (20 to 30 cm.)

Note: 4 inches (10 cm.) storage

Source: Atlas of Alberta,
Government of Alberta
and The University of
Alberta, 1969.

Map 1-2 Average Moisture Deficiency in Alberta


PEACE RIVER
Peace River
Grande Prairie
Fort McMurray
ATHABASCA RIVER
CHURCHILL
Edmonton
NORTH SASKATCHEWAN RIVER
Red Deer
RED DEER RIVER
Calgary
SOUTH SASKATCHEWAN RIVER
Medicine Hat
Lethbridge
MILK
LEGEND
Major River Basins
Rivers and Lakes

Source: Atlas of Alberta, Government of Alberta and The University of Alberta, 1969.

Map 1-3 River Basins of Alberta

As may be noted on the following map (Map 1-1, MEAN ANNUAL PERCIPITATION IN ALBERTA), mean annual percipitation ranges from approximately 25 inches (63.5 cm) in the foothills to less than 12 inches (30.5 cm) in the southeast. Precipitation in the northern portion of the province also falls below 16 inches (40.6 cm), but relatively few of the population centres are in this region.

A more significant indicator than amounts of precipitation in determining the dryness of a region is the index of moisture deficiency (the amount by which precipitation falls short of the need after soil moisture storage is exhausted). Practically all of Alberta suffers some moisture deficiency, ranging from an annual mean of approximately one inch (2.54 cm) in the west to 10 inches (25.4 cm) in the southeast (Map 1-2, AVERAGE MOISTURE DEFICIENCY IN ALBERTA).

However, the true measure of water supply in the prairies is streamflow, in which case Alberta faces a "restricted" supply. The availability of streamflow in Alberta is diminished for two reasons. First, major diversions are now under a moratorium, and the largest part of total streamflow is flowing northward and away from where the demand is located; second, the largest proportion of Alberta's population is dependent upon the flows of the North and South Saskatchewan Rivers (see Map 1-3, RIVER BASINS OF ALBERTA), but by a 1969 agreement with Saskatchewan and Manitoba, Alberta is allowed to deplete only one half of the natural flow of these two rivers[4].

Ground water is also inadequate for use as a source of supply for large centres. Local recharge of groundwater is limited in the prairies, and there is little potential for sustained use on a large scale[5].

In light of the "restricted" supply of water in Alberta, its efficient use may become more important in the future. The competition for water for industrial, municipal, agricultural, and even recreational uses may increase with population and economic growth, particularly within the drier regions of the province. For this reason, studies which cast light on the factors underlying inefficient use and the barriers to efficient use of water in Alberta should not be without merit.

FOOTNOTES

[1] T. O'Riordan, Perspectives on Resource Management, (London, England: Pion Limited, 1971), p. 60.

[2] O'Riordan, p. 60.

[3] Robert K. Davis, The Range of Choice in Water Management: A Study of Dissolved Oxygen in the Potomac Estuary, (Baltimore: RFF, Johns Hopkins, 1968), p. 8.

[4] Frank J. Quinn, Area of Origin Protectionism in Western Waters, Social Science Series No. 6 (Ottawa: Information Canada, 1973), p. 65 and 94.

[5] Arleigh H. Laycock, "Water", in Canada: A Geographical Interpretation, educational edition, p. 112-136, ed. John Warkentin (Toronto: Methuen, for the Canadian Association of Geographers, 1970), p. 118. See also P. Meyboom, "Estimates of Groundwater Recharge on the Prairies", in Water Resources of Canada, ed. Claude E. Dolman (Toronto: University of Toronto Press, 1967), pp. 128-153.

CHAPTER 2

BEHAVIOURAL STUDIES IN GEOGRAPHY

Basic to this thesis is the analysis of how residential water managers perceive management alternatives in the solution of residential water supply problems, why they perceive them as they do, and what impact their perceptions and attitudes may have on the use of these alternatives. Prerequisite to this analysis is an understanding of the theories relating to perceptions and attitudes as concepts, how they are formed, and what role they play in the behaviour of individuals, and subsequently in the manner of use of our environment. Useful also, in terms of putting this study in perspective with other research, is some knowledge of the types of perception and attitude studies which have been done in geography and the manner in which such studies may be applied to decision making in a resource management situation.

In light of the above, attention in this chapter will be directed toward the definition of perceptions and attitudes; toward defining the role of perceptions and attitudes in behaviour; and toward outlining the utility and application of behavioural studies to resources management. Preceding the above, the theoretical and practical beginnings of behavioural studies in geography are examined. The intention in this review is not to undertake a comprehensive survey of the literature, which is volumunious; rather, the intention is to provide only the conceptual basis on which behavioural geography is founded and to indicate the types of studies which have grown from this base.

THEORETICAL AND PRACTICAL BEGINNINGS

Concern with perceptions and attitudes was first registered by geographers in 1947, when Wright[1] distinguished between the mental dispositions of people as either objective or subjective. Wright's major contribution was in his definition of subjectivity as "a mental disposition to conceive of things with reference to oneself"[2], and his application of this subjectivity to the individual's interpretation of the environment.[3]

In his analysis of subjectivity in geography, Wright was beginning to define the subjective or ego-centred approach to interpretation of environment. However, it may be argued (as it is by Bunting and Gallant[4]) that the initial theoretical basis for the ego-centered approach was provided by Boulding in 1956, in a short book entitled The Image[5], in which the relationships between perception, attitudes, behaviour, and subjectivity are conceptualized. In The Image, Boulding "developed the concept of image or perceived reality as a mediating link between environment and man. Hence, to understand the relationship between environment and behaviour Boulding argued one must also understand the image".[6]

Boulding's concept of the image is based on the premise that everything which an individual knows about his world is knowledge. However, since a large part of what people know is "subjective knowledge" - that is, knowledge which they believe to be true or accurate, but is not necessarily so - Boulding equates this knowledge to an "image" the individual has of his world. Behaviour, in turn, is a function of this image.[7] That is to say, in reference to the traditional "stimulus - organism - response" model, behaviour is not dependent solely upon the stimulus or what Boulding calls "messages", but rather upon the "image" which dictates the response to the stimulus.

Boulding covers a much wider spectrum in his book than that indicated here, but it is the above which is most basic to understanding the relationships between perceptions, attitudes, and behaviour. The object of behavioural studies in geography might still be summarized as attempts to understand "the image".

The argument that decision making is subjective was reinforced by Lowenthal[8] in 1961. Continuing from Wright's theme noted earlier, Lowenthal's argument may be summarized as saying that "decisions at the scientific or lay level are always the products of facts (phenomena) subjectively processed for signficance".[9] That is to say, the facts are interpreted and acted upon in light of the decision maker's "image".

Beyond the early work which preceded Lowenthal's writing in 1961, little theoretical or methodological work has been done which can be applied to behavioural studies in general.[10] Nevertheless, based on the idea of subjectivity, some early practical work was undertaken.

The emphasis in the first perceptual studies was directed towards "hazard perception". This area of study focused mainly on floods and drought and attempted to delimit the reasons for various adjustments made by people to these hazards. In 1962, Kates completed a study entitled Hazard and Choice Perception in Flood Plain Management[11], in which he found that resource managers tend to make their decisions in a manner affected more by a concern for satisfying than for optimizing. In 1966, Saarinen[12] turned to the perception of drought on the Great Plains, and in subsequent studies, consideration has been given to the perception of hazards such as air pollution, avalanches, earthquakes, snow, tidal waves, and hurricanes.[13]

Interest in perception has spread to other areas of geography such as landscape, urban environments, outdoor recreation, and aspects of resource management beyond natural hazards. Perception studies related to landscapes and urban environments were initiated when Lynch attempted to empirically test the concept of image in The Image of the City.[14] Lowenthal and Prince[15] expanded this to a larger scale when they considered the visual qualities of the English landscape. Since then, perceptual studies have expanded into other aspects of "landscape" which include all scales from the room to the world.[16]

Perception studies in outdoor recreation stemmed from an initial study in Quetico - Superior Park by Bultena and Taves [17] on the implications of different perceptions of wilderness areas to the recreational use of these areas. Lucas[18] expanded on this study in 1964 and found differences in perceptions of wilderness between managers and users, and amongst users. Lucas[19] also found that these different perceptions affected the quality of the recreational experience and thereby provided an example of how behavioural studies can be used to enhance the recreational environment as well as to improve planning.

The above discussion is intended only to suggest the areas of geography in which perception and attitude studies are being applied. The volume of literature available precludes an in-depth coverage, and more value would be obtained through reference to an overview of the field, such as that provided by Saarinen.[20] In addition, the types of studies noted above are only indirectly related to the particular perspective of the behavioural study undertaken in this thesis. Those studies which have a more direct bearing on the theory and methodology used in this research project are reviewed later in the chapter, under the section entitled "Perception Studies in Resource Management".

PERCEPTIONS, ATTITUDES, BEHAVIOUR

Perceptions

The term "perception", as used in this thesis, is not used to refer to the neurological aspects of perception. Rather, the term is used in the sense of "social perception". The term social perception is used to refer to "the effects of social and cultural factors on man's cognitive structuring of his physical and social environment".[21] Perception, then, constitutes one aspect of the "image", which may be conceptualized as the "black box" between stimulus and response. Like the "image", which depends on more than the stimulus present, perception "is modified by the perceiver's past experience in general, his previous experience with that same or similar stimulii, and the individual's state at the moment he is viewing the stimulus of interest".[22] Consequently, perception depends upon the background of the perceiver; the value of the object to the perceiver; and habituation. The concept of habituation implies that to perceive something, one must first be aware of it.[23] Perception should only be applied to "those instances in which there is an actual stimulus to be perceived"[24], and should not be used to refer to "beliefs about environmental events which are not at the moment present, and which the respondent may himself never have experienced".[25]

Attitudes

An attitude may be defined as "a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related".[26] Thus, it may be said that attitudes represent an individual's beliefs about the object of the attitude, and just as a person's "image" consists largely of subjective knowledge, people seem to know what they like or dislike, even regarding objects about which they actually know very little.[27]

Attitudes have been recognized by psychologists as having three distinct components: the cognitive component, the affective component, and the conative component.[28] The cognitive component refers to how the attitude object is perceived. That is, it is the "stereotype" of the object as the individual believes it to be. The affective component deals with the feelings of liking or disliking about the object by the individual. The conative, or behavioural component refers to the person's gross behavioural tendencies regarding the object of the attitude.

The individual tries to balance out these three components of the attitude, creating two subclasses of behaviour: "(1) balanced attitudes, whose three components are consistent, and (2) ego defensive attitudes whose components are not consistent".[29] If the components of the attitude are not kept consistent within the individual, he becomes psychologically uncomfortable, and he adjusts one of his cognitions to make the situation consonant. If the relationship out of balance is external, it is referred to as cognitive consistency or congruity.[30] If it is an internal relationship which is out of balance, it is referred to as cognitive dissonance.[31]

It is an individual's attitude toward an object or class of objects which determines how he will react to that object when he encounters it.[32] Moreover, "attitudes can be ascribed to some basic bipolar continuum with a neutral or zero reference point, implying that they have both direction and intensity and providing a basis for the quantitative indexing of attitudes".[33] Both direction and intensity (or magnitude[34]), are important factors in accounting for behaviour. Just as it is the impact of messages on the certainty of the "image" which is of great importance in the interpretation of human behaviour, the variations in the strength as well as the magnitude of an attitude will account for variation in human behaviour.

Perceptions, Attitudes, Behaviour

In undertaking behavioural studies in geography, it is difficult to differentiate between perceptions and attitudes; both develop as a result of past experience, and both affect each other. Perceptions, though, tend to be more transitory, and may lack either the affective or cognitive component of the attitude. Nevertheless, perceptions (like attitudes) will produce behaviour, although this behaviour is more immediate, and the reaction is to a specific stimulus. Attitudes tend to be more general, and the reaction is to a class of stimuli.[35] For example, if a residential water manager imposes rationing during an unusually dry summer because the storage level of the reservoir has dropped, this would be an example of perception and the resulting behaviour. However, if the same situation occurred in the following years, the water manager might develop an attitude toward water shortages, and his behaviour would stem from that attitude. Thus, the manager might impose rationing or other conservation measures automatically, or he may begin to search for new sources of water, or develop a greater storage capacity.[36]

The understanding of behaviour is the main concern of perception and attitude studies in geography, and the term behaviour perhaps requires some clarification. Although behaviour is normally thought of as some overt act which can be observed, this definition does not allow for a very wide scope of research, and only allows for studies of what people have already done, not what they intend to do or would do in particular situations. Thus, in predictive, or at least "anticipatory" studies, the concern is usually with verbal behaviour, in which case the researcher is simply asking the subjects what their attitudes are.

The argument exists, of course, that people will say one thing and do another. This inconsistency may depend on two things. First, there is the problem of dissonance which was discussed previously, and which can result in inconsistent behaviour. Second, the inconsistency may be explained by degree of commitment,[37] which may be deduced to some extent through measuring the magnitude of the attitude as well as direction. For example, a water manager may say that people should not be allowed to use as much water for lawn-watering, but he may not be willing to subject himself to the unpopularity possibly associated with rationing or higher prices.

It should be noted that the measurement of perceptions and attitudes, particularly in a real world setting, is still not subject to a proven or rigorous methodology. Thus, a discussion of the methodology employed in this study is included in the chapter on "Research Methodology".

WHY STUDY PERCEPTIONS AND ATTITUDES IN RESOURCE MANAGEMENT?

Decision Making and Policy Formulation

> Resource management in the final analysis is a decision making process where optimal solutions regarding the manner, timing, and allocation of resource use are sought within the economic, political, social, and institutional framework afforded by any given culture at a particular time.[38]

The preceding definition of resource management as a decision making process focuses attention upon the role of the resource manager and his interpretation of his environment. The above definition, and the rationale behind studying the behaviour of resource managers is based upon a conceptual "model" put forth by White.[39] White bases his model on the assumption that "at the heart of managing a natural resource is the manager's perception of the resource and of the choices open to him in dealing with it.[40] The essence of White's[41] model is that in a given situation a resource manager has a "range of choice" from which to make a decision. For example, in the case of a water shortage, a residential water manager would have the choice of several alternatives from both categories of solutions (management and construction oriented) from which to decide.

Theoretically, constraints on this range of choice should stem only from the physical environment and technology. However, the theoretical range of choice is further limited by a practical range of choice which is delimited by the culture and institutions which either permit, prohibit, or discourage a given choice. Finally, there is the actual selection of alternatives, which depends upon the way in which the manager interprets the different elements in the course of his decision making process.[42]

How the resource manager perceives the limitations, restrictions, and alternatives which accrue to a particular situation will have almost complete influence over his behaviour, and hence his decision. Consequently, to understand the manager's decisions, it is necessary to obtain some insights into how he perceives a particular resource management or decision situation, and why. As will be illustrated in the following section, this understanding may be useful in decision making and policy formulation in various ways.

Perception Studies in Resource Management

> Research on perception in resource management could be considered a search to understand the widening gap between available scientific knowledge and the practical application of this knowledge.[43]

The above statement suggests both the need to understand why resource managers do not consider the full range of available alternatives and axiomatically the utility of perception and attitude studies in resource management. The statement is particularly appropriate to this thesis, for concern lies with determining why management alternatives are not being practically applied to residential water supply problems to any great degree, although past research has shown them to be significant policy alternatives.

To date, it has been demonstrated by behavioural studies "that perceptions and attitudes do play a significant role in decision making".[44] It has been documented in these studies, as suggested in the previous pages, that a person's decisions are affected not only by past experience and knowledge, but by institutional guides and what the decision maker feels to be the preferences of others.[45] Thus, a decision maker or resource manager should understand both his own perceptions and attitudes, as well as those of others. Not only would this help to narrow down the possible alternatives to a "practical range of choice", but would also help to alleviate the problem of a resource manager imposing artificial restrictions upon himself because he has not perceived all of the alternatives to a problem.

The negative effects of a resource manager's perceptions and attitudes may manifest themselves in the decision situation in several ways. Baumann[46] documented the relationship between attitudes and decision making as affected by resource managers, their perceptions of what people want, what they themselves want, and what they think the people should want. Baumann's subject was the use of domestic water supply reservoirs for recreational purposes. Throughout most of the United States, reservoirs are used for recreation, whereas in the northeastern states, where the demand for outdoor recreation is most acute, the reservoirs are not developed for that purpose.

Baumann found that the nature and extent of the recreational use of water supply reservoirs, and the sharply differing regional views as to such use, had their roots in managerial knowledge and attitudes. That is, the manner in which both public health officials and water managers perceived the impact of recreation upon the sanitation problems of water from the reservoirs was based more upon attitudes than scientific knowledge. This was the case both in areas where recreation was allowed and in areas where it was not allowed.

Baumann also found that the water managers enlisted the support of the public, which tended to reflect the attitudes of the water manager. That is to say, "the water managers' perceptions are reinforced by the feedback that the public will not tolerate anyone 'swimming in their drink', and public attitudes coincide with the views of the water managers".[47] Consequently, "existing social guides, managerial perceptions, and public attitudes serve to reinforce each other".[48]

An additional aspect related to the effects of perceptions and attitudes in decision making is that water managers will tend to choose the alternatives which are most familiar. MacIver[49] found this to be the case amongst water managers in the Grand Basin in Southern Ontario. Groundwater experts, for example, tended to suggest that wells would solve the supply problem for cities in the upper part of the basin. River managers suggested that the river would be the best source of supply. This tendency, of course, is related to the effects of past experience and knowledge on perception.

MacIver[50] also found that association with a particular institution tended to bias the choice of alternatives. For example, members of the Conservation Authority would all stress one particular choice, and the Ontario Water Resources Commission another.

Somewhat related to institutional bias and loyalty is that of professional loyalty. For example, evidence suggests that in the water field engineers tend to be the dominant profession.[51] The concern here results from studies (Sewell[52], Silberman[53]) suggesting that engineers, "owing to their training and the ethics of their profession, tend to canvass alternative solutions along the somewhat restricted lines of the structural monument".[54] Thus, engineers involved in residential water supply problems would probably tend to recommend alternatives from the construction category, and management alternatives would not be perceived as a viable part of the solution.

Why Study Perceptions and Attitudes of Residential Water Managers in Alberta?

The significance of the perceptions and attitudes of the resource manager in the decision making process have been dealt with in the preceding pages of this chapter. However, it seems appropriate to consider in some detail the "identity" of the residential water manager in Alberta, and his role in the decision making process.

In Alberta, as in most instances in Canada, the "water manager" is not usually the decision maker, but plays the role of manager of the water system and advisor to the decision making body, which is usually the town or city council. The recommendations of the water manager may include his own solutions to a problem, and may also be affected by advice from consulting firms or other government agencies, by opinions expressed by people in the community, and by his perception of what the decision making body expects.

Thus, as O'Riordan[55] notes, the decision making process may be influenced by a technical elite of professional resource managers such as engineers, public health inspectors, medical health officers, biologists, and so on. These professionals may play various roles such as consultants, advisors, planners, supervisors of management programs, and administrators, and may be employed in either private concerns, public agencies, or in a personal consultative capacity. They may have direct responsibility for decision making, or play only a minor role in the overall decision-making process. The perceptions and attitudes of these resource managers become important, therefore, because of the influence they may have "on the decision maker's interpretation of the problem, his choice of relevant alternatives, his preferences for outcome, and in general, his views as to the ways in which resources should be managed".[56]

In Alberta, the decision maker is usually a political body. However, it is reasonable to assume that the decisions are affected in the above manner by the recommendations of the local water manager, sometimes combined with outside advice from consultants or provincial government agents. However, it is normally the "water manager" who must assess outside reports, plus the attitudes of the public, plus the physical and financial situation of the water supply system, and synthesize these into recommendations to the city or town council. In the majority of Alberta towns, the "water manager" is usually the municipal secretary, clerk treasurer, or town manager. The larger cities usually have their own engineer who is responsible for the management of the system, and he reports to the city council.

Since it is the "water manager" who usually makes the recommendations as to solutions, and who probably has the most influence on the final decision, it is that person who should receive primary study. For, it is that person who will suggest the categories of alternatives to be used to solve problems, as well as suggest the price to be charged. Efforts, of course, should also be directed towards determining the perceptions and attitudes of the decision making body, outside consultants, and the public. Nevertheless, the perceptions and attitudes of the water managers should go some distance in explaining the choice and use of water management alternatives. Moreover, recalling Baumann, it is possible that the water managers will reflect the attitudes of the decision makers and the public.

SUMMARY

In the preceding pages, attention has been devoted to the role of perceptions and attitudes in the process of decision making. Essentially, it may be concluded that perceptions and attitudes depend largely on past experience and knowledge (accurate or otherwise), and on cultural and institutional guides which are superimposed upon this knowledge. The research to date supports the importance assigned to the role of perceptions and attitudes to decision making and the choice of alternatives.

In the following chapter, the management alternatives open to a residential water manager to efficiently meet the demand for water are reviewed. Since the basic premise in this thesis is that the choice of these alternatives is dependent upon perceptions and attitudes, considerable effort is directed towards the documentation of their utility and to the underlying theories behind their use.

FOOTNOTES

[1] John K. Wright, "Terrae Incognitae: The Place of Imagination in Geography", Annals AAG, Vol. 37 (1947), pp. 1-15.

[2] Wright, p. 5.

[3] For a more complete discussion of subjectivity in interpretation of environment as it relates to decision making, see Ian MacIver, Urban Water Supply Alternatives: Perception and Choice in the Grand Basin, Ontario, Department of Geography Research Paper No. 126 (Chicago: University of Chicago, 1970), pp. 7-9.

[4] T. Bunting and V. Gallant, "The Environmental Grab Bag", in Geographical Inter-University Resource Management Seminar, Paper No. 6, ed. J. Lewis (Waterloo: Waterloo Lutheran University, January, 1971), p. 23.

[5] Kenneth E. Boulding, The Image (Ann Arbour: University of Michigan, 1956).

[6] Bunting and Gallant, p. 23.

[7] Boulding, "Foreword", in Image and Environment, ed. Roger M. Downs and David Stea (Chicago: Aldine, 1973), p. viii.

[8] David Lowenthal, "Geography Experience, and Imagination: Towards a Geographical Epistemology", Annals AAG, Vol. 51 (1961), pp. 241-260.

[9] MacIver, p. 9.

[10] This argument is well documented by Bunting and Gallant, p. 21-23; and by Thomas F. Saarinen, Perception of Environment, Resource Paper No. 5, (Washington, D.C.: Association of American Geographers, 1969), pp. 3-4. Hereafter referred to as Saarinen (1969).

[11] Robert W. Kates, Hazard and Choice Perception in Flood Plain Management, Department of Geography Research Paper No. 78 (Chicago: University of Chicago, 1962). This was the first study of an entirely "social" nature. White undertook a hazard study as early as 1945, but it was more physical in nature; see Gilbert F. White, Human Adjustments to Floods, Department of Geography Research Paper No. 29 (Chicago: University of Chicago, 1946).

[12] Thomas F. Saarinen, Perception of the Drought Hazard on the Great Plains, Department of Geography Research Paper No. 106 (Chicago: University of Chicago, 1966).

[13] See Anita Cochran, A Selected Annotated Bibliography on Natural Hazards, Natural Hazard Research Working Paper No. 22 (U.S.A.: University of Colorado, 1972).

[14] Kevin Lynch, The Image of the City (Massachusetts: M.I.T. Press, 1960).

[15] David Lowenthal and Hugh C. Prince, "The English Landscape", The Geographical Review, Vol 54, No. 3 (July, 1964), p. 309-346. See also Lowenthal and Prince, "English Landscape Tastes", The Geographical Review, Vol. 55, No. 4 (April, 1965), pp. 188-222.

[16] For a collection of major works related to the various "levels" of environmental perception, see Harold M. Proshansky, et al, eds, Environmental Psychology (Toronto: Holt, Rinehart, and Winston, 1970).

[17] Gordon L. Bultena and Marvin J. Taves, "Changing Wilderness Images and Forestry Policy", Journal of Forestry, Vol. 59 (March, 1961), pp. 167-171.

[18] Robert C. Lucas, "Wilderness Perception and Use: The Example of the Boundary Waters Canoe Area", Natural Resources Journal, Vol. 3, No. 3 (1964), pp. 394-411.

[19] For additional examples of this utility, see Ashley Schiff, "Outdoor Recreation Values in the Public Decision Process", Natural Resources Journal, Vol. 6 (October, 1966), See also, Edward L. Shafer, "Perception of Natural Environments", Environment & Behaviour, (June, 1969).

[20] Saarinen, (1969), has provided such an overview, and has organized it according to the areal scale of the research.

[21] Saarinen, (1969), p. 5.

[22] Myra R. Schiff, Some Theoretical Aspects of Attitudes and Perception, Natural Hazard Research Working Paper No. 15 (Toronto: University of Toronto, 1970), p. 2. Hereafter referred to as Schiff, (1970). See also Schiff, "The Definition of Perceptions and Attitudes", in Perceptions and Attitudes in Resources Management, ed. W. R. Derrick Sewell and Ian Burton, Resource Paper No. 2, Policy Research and Coordination Branch, Department of Energy, Mines, and Resources (Ottawa: Information Canada, 1971), pp. 7-13. Hereafter referred to as Schiff, (1971).

[23] Schiff, (1970), pp. 2-5.

[24] Schiff, (1970), p. 5.

[25] Schiff, (1970, p. 5. For a more complete discussion of "social perception", also see Henri Tajfel, "Social and cultural factors in perception", in The Handbook of Social Psychology, Vol. 3, 2nd Edition, ed. Gardner Lindzey and Elliot Aronson (U.S.A.: Addison-Wesley, 1969), pp. 315-394.

[26] G. W. Allport, "Attitudes in the History of Social Psychology", in Attitudes, ed. Marie Johoda & Neil Warren (Great Britain: Penquin Books, 1966), p. 20.

[27] William J. McGuire, "The Nature of Attitudes and Attitude Change" in The Handbook of Social Psychology, Vol. 3, 2nd Edition, p. 157.

[28] McGuire, pp. 155-157.

[29] McGuire, p. 157.

[30] An example of an internal relationship out of balance would be a water manager who does not believe that people will reduce consumption of water if the price is increased, but is confronted with evidence to the contrary. To make the inconsistency consonant, the water manager might refuse to accept the statistics as valid, or if they are not deniable, may change his mind. For further discussion see Schiff (1970), pp. 7-9. See also R. B. Zajonc, "Balance, Congruity, and Dissonance", in Attitudes, pp. 261-277. Or, to consider the original theory, see Leon Festinger, A Theory of Cognitive Dissonance (New York: Row-Peterson, 1957).

[31] An external relationship, for example, would be between yourself, a friend you respect, and an "idea" that you dislike. If your friend liked the idea and you didn't, it would be a case of cognitive consistency, because you would not expect someone you liked to like things you didn't. To solve the inconsistency you might decide that you liked the "idea" after all, and the situation would become consonant.

[32] Schiff, (1971), p. 8.

[33] Charles E. Osgood, et al, "Attitude Measurement", in Attitude Measurement, ed. Gene F. Summers (Chicago: Rand McNally, 1970), p. 227.

[34] For a discussion of the usage of the two terms "intensity" and "magnitude", see William A. Scott, "Attitude Measurement", in The Handbook of Social Psychology, Vol. 2, 2nd Edition (1968), p. 206.

[35] Schiff, (1970), p. 13.

[36] For further examples illustrating this distinction between perception and attitude, see Schiff, (1971), p. 10.

[37] Schiff, (1971), p. 10.

[38] O'Riordan, Perspectives on Resource Management, (London, England: Pion Limited, 1971), p. 60.

[39] Gilbert F. White, "The Choice of Use in Resource Management", Natural Resources Journal, Vol. 1 (1961), pp. 23-40. Hereafter referred to as White, (1961).

[40] Gilbert F. White, "Formation and Role of Public Attitudes", in Environmental Quality in a Growing Economy, ed. Henry Jarrett (Baltimore: Johns Hopkins for Resources for the Future, 1966), p. 105.

[41] White, (1961), p. 29.

[42] Implicit here is the role of "goals" in how a manager judges the desirability of alternatives. In the field of residential water supply where final decisions are usually made by political bodies, goals can also be political, and hence variable. The range of goals often considered is discussed in Chapter 3, under the section of "Objectives in Pricing & Metering". For a discussion of how goals are formulated in public policy, see O'Riordan, pp. 110-114.

[43] Thomas F. Saarinen, "Research Approaches and Questionnaire Design", in Perception and Attitudes in Resources Management, p. 13.

[44] Ian Burton, "The social role of perception and attitude studies", in Perceptions and Attitudes in Resources Management, p. 3.

[45] Burton, p. 3.

[46] Duane D. Baumann, The Recreational Use of Domestic Water Reservoirs: Perception and Choice, Dept. of Geography, Research Paper No. 121 (Chicago: University of Chicago, 1969).

[47] Baumann, p. 71.

[48] Baumann, p. 75.

[49] MacIver, p. 143.

[50] MacIver, pp. 130-133.

[51] O'Riordan, p. 105.

[52] W. R. Derrick Sewell, "Environmental Perceptions and Attitudes of Engineers and Public Health Officials", Environment and Behaviour, Vol. 3, No. 1 (March, 1971), pp. 23-59.

[53] Edward Silberman, "The Engineer's Role in Water Resources Planning", Water Resources Bulletin, Vol. 5, No. 1 (March, 1969), pp. 47-52.

[54] O'Riordan, p. 105.

[55] O'Riordan, p. 103.

[56] O'Riordan, p. 103.

CHAPTER 3

MANAGEMENT ALTERNATIVES IN RESIDENTIAL WATER SUPPLY

Consistent with the decision making models discussed in the previous chapter, any water manager who considers it desirable to reduce the consumption of residential water has a range of alternatives to choose from by which he might accomplish this goal. This range of alternatives may include pricing, metering, rationing, and exhortation. All of these alternatives, when properly employed, should contribute to the more efficient use of water.

The object in this chapter is to give consideration to the alternatives (range of choice) of a managerial nature open to water managers, and to illustrate the benefits of, and the positive arguments for, the use of these alternatives. The following areas of discussion will be pursued: one, the reasons why residential water is of concern to those searching for efficiencies in the use of water resources; two, the theoretical means of attaining efficiency in residential water use; three, the characteristics of residential water supply and demand which make it amenable to the application of efficiency criteria; four, the various management alternatives, the assumptions upon which they are based, and their apparent effectiveness in changing the quantity demanded; and five, the use of management alternatives in Alberta which has been documented to date, and the implications of this use to demand chacteristics.

RESIDENTIAL WATER USE: THE NEED FOR EFFICIENCY

Past trends of both per capita and total consumption of residential water have been dramatically upward. In the United States, per capita consumption has increased by four to five times in the past 50 years.[1] Very conservative estimates by Wollman and Bonem[2] indicate that withdrawals for municipal use will rise from an actual average of approximately 128 imperial[3] gallons per capita per day (gpcd) (582 lpcd) in 1960, to 173 gpcd (786 lpcd) in 1980, to 202 gpcd (918 lpcd) in 2000, to 223 gpcd (1014 lpcd) in 2020.

The projections of per capita consumption combined with projected rates of world population growth and urbanization provide an indication of future needs for municipal water. Projections indicate a doubling of the 1962 figure of 1,200 million people living in cities to an estimated 2,500 million in the year 2000.[4] For many countries this growth will mean the initial construction of water supply facilities to service urban areas, often without concern for individual homes.[5] For North American cities, it means the continuation of vast expenditures on water treatment and distribution facilities, as well as the consumption of large amounts of water, particularly if past levels of service are to be maintained. In North America, this growth is already creating a twofold problem: that of volume used, and that of the costs resulting from the increased demand.

The problem of using large volumes of water has two aspects. The most obvious result of using large quantities is the possibility of shortages. In North America, however, water shortages in municipal systems generally result from allocation problems. That is, a certain volume of available water is allocated to various uses such as agricultural irrigation, industry, and recreation, as well as municipal use. Walker and Skogerboe[6] suggest that this is the case in the western United States, where shortages stem mainly from the unavailability of unappropriated water resources within the hydrologic unit. Much the same situation appears to be materializing in the southern Prairie Provinces of Canada where, according to Quinn,[7] most of the available flow of the South Saskatchewan River and its tributaries has been allocated, while other major rivers flow northward and away from major population centres.

Whether or not the use of large volumes of water becomes a problem is dependent largely upon "the effect that the use has upon quality of water and upon time and location of its availability to the other potential users".[8] In the case of municipal systems, the actual amount of water used for consumptive purposes is quite low, running somewhere between 10 and 20 percent.[9] However, the externalities imposed upon downstream users of those streams receiving urban effluent, and the rising standards of quality being placed on these streams, is beginning to cause concern about the volume of water used by the municipal system which will subsequently require treatment. If, as Kuiper[10] suggests, the ratio of required flow to sewage is 40 to 1 for raw sewage, and 2 to 1 for thoroughly treated sewage, rising standards are going to increase sewage treatment costs to maintain acceptable standards of quality. Reducing the amount of water used will not only reduce the costs of sewage treatment, but might reduce costs imposed upon downstream users in the form of such things as lost recreational benefits or even increased water treatment costs for downstream municipal systems.

The second problem resulting from the growth in demand is quite simply the cost of supplying the water. These costs are incurred in the capital investment required to construct treatment plants and distribution systems, as well as the rising costs associated with the actual treatment of the water. Moreover, as communities expand and requirements increase, it is often necessary to go considerable distances to find new sources, resulting in expensive pipelines and pumping facilities. Thus, water supply costs continue to demand large portions of municipal revenues which, in a growing community, might well be needed for health, welfare, education, urban renewal, or other social programs.

It is largely because of the problems associated with the increasing demand for water that a considerable amount of concern has been focused upon urban water supply in the past few years. Much of this concern has been directed towards residential water alone due to the large portion of total urban demand taken up by residential supplies, the high rate of investment per unit of volume delivered, and the high priority which policy makers give to meeting the demand for residential water.

The portion of total urban supplies taken by residential demand varies with city size, with larger cities providing more to industrial, commercial, and public uses than smaller communities. In a survey of American urban areas with populations exceeding 25,000 undertaken in 1964 by Hittman and Associates,[11] the weighted average water use pattern showed 42 percent going to residential purposes, 41 percent to industrial and commercial customers, and 17 percent to public uses. In smaller towns, or in areas such as the Prairie Provinces where the manufacturing sector may be relatively small, much less water would be demanded by the industrial, commercial, and public sectors. Kuiper[12] suggested that differences in the latter two uses would increase consumption from about 100 gpcd (454 lpcd) in smaller cities and towns in the United States to about 150 gpcd (681 lpcd) in larger cities.

Residential water demand appears particularly amenable to adjustment due to the demand characteristics and because few attempts have been made to gain any degree of economic efficiency in the provision of residential water. Thus, in the following section, consideration will first be directed towards how the historical approach to providing residential water has resulted in the need for efficiency, and then towards what efficiency in residential water use will mean.

EFFICIENCY IN RESIDENTIAL WATER MANAGEMENT

The present approach of fitting the supply of residential water to the demand and the subsequent status of residential water as a "noneconomic" good has its roots in history. Originally, as Grima[13] summarizes it, a good source of treated water became a necessity in urban environments to reduce water-borne disease. Charges for the water were kept low to encourage residents to install the necessary plumbing fixtures. As the cities expanded over time, consumption of water was further encouraged through low prices and unlimited quantities because residential lawn watering, fountains, and gardens were all felt to contribute to the overall amenities of the community.

Water has also been seen as an essential good. While this of course is true, it has apparently resulted in water supply systems being designed on the assumptions that residential water demand is inelastic with respect to price and that legal and physical restrictions are unpopular.

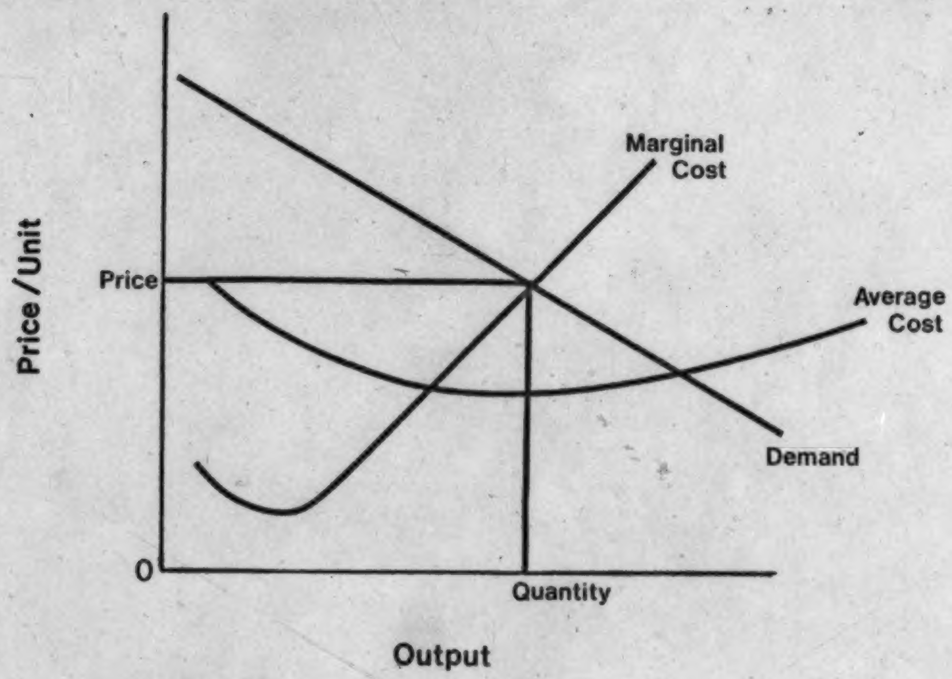
It is a consequence of the above attitudes and policy approaches that residential water is being supplied largely through the "requirements" approach. Essentially, the requirements approach implies the convenient calculation of future needs by taking per capita consumption, adjusting it for expected changes in local demand, and then multiplying by projected population. The resulting requirement is taken as a fixed quantity which must be supplied. Consequently, economic analysis becomes only a search for the least costly supply, with no effort directed towards altering the demand function, and subsequently the requirements.[14] Thus, the requirements approach ignores the relationship between per capita demand and price, and thereby the efficiency principle.

The efficiency principle "requires that the rate of output of any commodity or service (such as delivered water) be extended to that rate at which incremental benefits equal incremental costs and beyond which additional benefits would fall short of additional costs".[15] The above principle requires that water be priced at marginal cost, or the cost of delivering the last unit of water, as opposed to the average cost of each unit of water (Figure 3-1).[16] A fundamental economic concept, marginal cost pricing is based on the principle that "as any one user 'consumes' more and more water, the value to him of the last water used becomes lower and lower. When a price tag is attached to water, each user will continue to use more and more water until the value to him of the last unit used is reduced to the point where it equals the price he is charged for the water. Thereafter he will stop using water".[17]

The objective in marginal cost pricing is to obtain values for water that are comparable to the price

FIGURE 3-1

PRICING AT MARGINAL COST



based values that allocate other resources and products throughout the economy.[18] Theoretically, then, the higher the price the less water the consumer will use, since willingness to pay for extra units' of water declines as the most essential uses are satisfied. This decline occurs because water has then become an "economic" good, in which case the consumer will have to sacrifice other goods to obtain the extra units of water. In the case of residential water, the assumption in marginal pricing is that the last few gallons demanded by consumers for, say, lawn watering, are less "essential" and yield less satisfaction than the first few gallons which are likely to be used for drinking, washing, and cooking.

Thus, price becomes a policy alternative which encourages the reduction of those uses of residential water which the consumer values less than the cost of providing the service. "This approach leaves the consumer with the choice of exercising his right to buy more water at a price that reflects its cost; at the same time, the management makes use of non-arbitrary criteria in attempting to allocate resources efficiently to the development of residential water supplies."[19]

Policies employing a marginal cost pricing approach also put the emphasis on "demand management" rather than on the supply fix. When demand management is used, future projections of demand and consequent expansions of supply facilities are based on demand curves adjusted for a relationship between per capita demand and price.

CHARACTERISTICS OF RESIDENTIAL WATER SUPPLY AND DEMAND

Residential water demand is subject to three phenomena which affect management practices in the supply of water: temporal variations in demand, generally increasing levels of demand, and spatial variations in demand. The temporal variation is perhaps the most significant characteristic which makes demand management particularly attractive.

Temporal Variations in Demand

A residential water supply system will have average annual demands placed upon it, plus peak season, peak month, peak day, and peak hour demands. Allowance for these variations must be made in the design of the water supply system, particularly in major transmission lines and treatment capacity, and the greater the variations the greater the cost. Gysi[20] found, for instance, that meeting the last 12 percent of a community's summer demands could almost double the required capital costs.

Peak demands vary considerably. Studies in the United States indicate a wide range of both average per capita consumption and peak demand levels. These variations may stem from the effects of such factors as climate, price, and economic conditions. In a study of 39 residential areas in the U.S.A., Howe and Linaweaver[21] found that average annual use ranged from 47 gpcd (214 lpcd) to 437 gpcd (1987 lpcd). The maximum day consumption ranged from 157 percent to 541 percent of average, and peak hour consumption from 247 percent to 1,650 percent of average.

General Increases in Demand

The factors which have resulted in the generally increasing demand levels on a per capita basis may be placed in four general categories: technological change, increasing affluence, social tastes, and policy decisions.

Technological change has affected residential demand through new water using products and new or improved

8

methods for the handling and distribution of water. Affluence has resulted in the increased use of water using appliances such as washing machines, dish washers, air conditioners, and in more spacious homes with large lawns to be watered. Changes in social tastes have increased demands through emphasis on cleanliness and personal hygiene, daily showers, homes with two or more bathrooms, increased numbers of washing machines, dish washers, air conditioners, and swimming pools. Policy decisions affect demand through pricing policies, extent of metering, subsidies, and water quality standards.

Spatial Variations in Demand

Spatial variation in demand refers to the different rates of use in different geographical areas. These variations result from the above factors, particularly affluence, social tastes, and policy decisions, as well as type of dwelling unit, and particularly climatic and soil conditions. Consequently, the spatial variation may be on as small a scale as neighbourhood to neighbourhood when conditioned by such things as affluence and dwelling type, or on as large a scale as the national or regional level, in the case of climate.

The impact of affluence is shown vividly in the consumption patterns of medium and high value homes (Table 3-1). Similar results to those shown in Table 3-1 were found in an Illinois study where during periods of maximum use, households having assessed values of 14-17 thousand dollars used 139 percent more water than houses assessed at 10-13 thousand.[22]

TABLE 3-1

DEMAND RATES FOR MEDIUM AND HIGH VALUE HOMES

Demand Period	Domestic	Sprinkling	Total
	Demand per service--gpd.(*m3pd*)		
Medium-value homes			
Average day	203 (*.9*)	46 (*.2*)	249 (*1.1*)
Maximum day	250 (*1.1*)	495 (*2.3*)	745 (*3.4*)
Peak hour	565 (*2.6*)	1,495 (*6.8*)	2,060 (*9.4*)
High-value homes			
Average day	195 (*.9*)	126 (*.6*)	321 (*1.5*)
Maximum day	290 (*1.3*)	2,030 (*9.2*)	2,320 (*10.5*)
Peak hour	860 (*3.9*)	3,540 (*16.1*)	4,400 (*20.0*)

SOURCE: F. Pierce Linaweaver, Jr., and John C. Geyer, "Use of peak demands in determination of residential rates", AWWA, Vol. 56, No. 4 (1964), p. 404.

Climate results in regional variations in demand mainly due to the different requirements for lawn irrigation, and possibly due to the use of air conditioners. Lawn watering has the greatest potential for causing variations, as shown by the findings of Wolff,[23] who reports that lawn sprinkling can constitute 80 percent of peak hourly demand, and 75 percent of total daily volume.

The characteristics of both the demand levels and the temporal distribution of demand levels suggest that efficiencies in residential water use should be possible. These efficiencies might be achieved through both rationing and a rational pricing policy which encourages more efficient use. The ultimate objective in a water supply system, of course, is to arrive at an optimal combination of structural investment and utilization of policy alternatives.[24] The role which pricing and metering might assume in arriving at this optimal solution is the subject of the following section.

PRICING AND METERING

Objectives in Pricing and Metering

The price set for water depends, of course, upon the objectives of those setting the price, these bodies in Canada normally being public service agencies such as civic departments, which are subject to political influence. Grima[25] lists seven objectives which may be distinguished in the setting of a price on municipal water. These objectives are:

1) to recover expenditures, which is the most common objective in the municipal water supply industry
2) to make a small profit to contribute to further expansion
3) to subsidize certain users (e.g. new industry), in the hope of gaining benefits from an expanded tax base
4) to make a small profit to reduce the level of municipal taxation; water is one of the few municipal services which can be operated at a profit
5) to redistribute income, which requires that small

users pay a lower price per unit than large users of water

6) to allocate resources efficiently by setting price equal to marginal cost, and thus equating marginal utility with marginal cost of production and with price

7) as a tool in the hands of management, pricing can be directed towards decreasing average and maximum day demand

The first four objectives are quite common to pricing practices in North America, the latter three are rarely observed.

While Grima suggests the influence of political factors in the choice of objectives for setting price, the United States National Water Commission is more explicit:

> Water utilities are public service enterprises. Their regulation by various politically elected and appointed officials may be aimed at accomplishing a number of objectives and only incidentally concerned with conserving and efficiently using water supplies.[26]

Thus, in setting its pricing and metering policies, a utility may reflect political policies such as promotion of industrial development, attempts to annex outlying areas of the city, or other political ambitions. The use of water utilities for such ends was documented in a survey of 200 water managers by researchers at the University of Florida (Table 3-2).

TABLE 3-2

CURRENT PRICING POLICIES OF WATER UTILITIES

Current Policies	Yes	No	No Response
1. Water utility is expected to be self-supporting	219	1	0
2. Present rate structure promotes:			
Location of new firms	172	37	11
Lawn sprinkling	140	64	16
Air conditioning	122	80	18
Recreation use	142	62	16
Other	30	13	177
3. Extension of water service used to:			
Force annexation	112	94	14
Extension of other municipal services	66	130	24
4. Utility provides			
Contributions to general fund of Local Government	124	90	6
Tax contributions	55	147	18
5. Utility provides:			
Free fire services	143	75	2
Free water to local government	86	133	1
Free water to other facilities	11	204	5

SOURCE: Fristoe, Charles W. et al., U.S. Office of Water Resources Research and University of Florida (1971). "Applied Criteria for Municipal Water Rate Structures". National Technical Information Service, Springfield, Va., Accession No. PB 202 013. p. 116. From National Water Commission, Water Policies for the Future, Final Report to the President and to the Congress of the United States, Washington, D.C.: U.S. Government Printing Office, June, 1973.

Types of Pricing

As suggested previously in this paper, present pricing policies for water do not, in most cases, take into account efficiency of use or conservation. The three common types of pricing in North America are declining block rate (DBR) or "promotional" pricing schedules; constant rate schedules, (i.e. a constant unit price for all consumers); and a flat rate or fixed monthly charge.

The DBR price schedule includes a minimum charge for a small initial quantity and decreasing price rates for ad-ditional units of water. This type of pricing encourages additional consumption of water. The customer is less concerned about excess use, since "the cost of the marginal gallon is always lower than the cost of his average gallon".[27] Nevertheless, in a review of 123 American cities in 1964-65, Gysi[28] found that 94 percent used declining block rates.

The reason given for using DBR schedules is usually that small customers cost proportionately more to service than large customers due to economies of scale, and therefore they should pay proportionately more. Gysi[29], however, considers this argument to be weak insofar as residential water supply is concerned. It is the large residential consumer who is relatively more responsible for peak consumption, and therefore for the cost of facilities to meet those peaks. "Once an initial flat fee is charged for metering, billing, and maintenance, the in-house domestic low-consumption user is cheaper per unit to supply than the large lawn-watering user".[30] Thus, the DBR schedule tends to discriminate, economically, against the small user.

The constant rate schedule was used by about 3.5 percent of the cities in Gysi's study. Constant prices are considered fairer than DBR in that they at least do not reward large consumers with lower average rates. This type of pricing is also approved of by economists because it assures equi-marginal value in use, and encourages conservation.

The flat rate, although rarely used by large cities at present, is still relatively common. This type of pricing provides absolutely no financial incentive to conserve water. Any action by consumers to conserve water under this type of schedule would impose costs upon them, without yielding any benefits.

There is one pricing schedule which does take account of economic efficiency and encourage conservation. This schedule is called incremental block pricing, and, as opposed to DBR, works on an increasing block rate (IBR). This schedule is considered to be the fairest by Gysi[31], particularly when the initial block of water per month is offered at a low rate, such as that rate which would equal marginal cost if only that block were demanded each month. In this type of plan, higher demand people end up buying more and paying more per unit. The narrower the price increments, or blocks, which are used, the better the individual's utility (or demand curve) will be reflected in his consumption.

Charging more to high demand customers is justifiable, Gysi[32] argues, because different consumption patterns are different commodities in that those persons responsible for peak capacity facilities can be said to be demanding a more expensive commodity, for which they can be justifiably charged.

An alternative pricing schedule to IBR which also encourages conservation is that of a summer differential rate, in which higher rates are charged during the season of highest consumption. This approach, though, does not increase the cost of water to those who demand the greatest volume, and thereby the greatest service.

Metering

Metering is more straight-forward than pricing, since it is largely a matter of measuring quantity. It may be argued that since there is really plenty of water for municipal purposes, the objective of metering is not to restrict consumption, but rather to prevent waste by providing a basis for charging the customer for what he uses. Nevertheless, metering can be used to make pricing policies more sensitive; for, with the use of demand meters it is possible to continuously measure both the quantity consumed and the time it is consumed. Such data allow for peak time charging, or differential summer rates.

There are physical costs associated with metering. These, essentially, are the cost of the meters, maintenance, and processing costs of water bills in excess of flat rate charges, including meter readers. The costs of reading the meters is perhaps the greatest in the long run, but there is the possibility in the near future of accomplishing this by telemetry (over telephone lines and into a computer). While still too expensive, this "remote sensing" of meters could become workable, particularly if combined with other utilities. Edmonton is currently evaluating the feasibility of such a system by combining water with gas and electric utility metering.

Effectiveness of Pricing and Metering

Presently, one of the greatest concerns related to the espousal of pricing and metering as a means of increasing efficiency in resource use is that of whether or not it is effective. Managers tend to assume a lack of responsiveness to pricing policies (and therefore restrict their range of choice), because of the feeling that water is cheap, water is essential to many household and personal needs, and it is a small item in the family budget. Similar objections are used against metering, particularly the suggestion that it does not reduce consumption, and if it does, the demand will return to normal levels after a short period of time.

While the question of metering bears further investigation, "the dominant opinion in the field of municipal water supply seems to be that universal metering produces gains that are worth the cost".[33] The installation of meters tends to accomplish two things: "first, users are made aware of the extent of their water use; second, water charges are, in effect, changed from a flat rate system of pricing to rates based on incremental use. Both the information and the financial incentive are important in achieving reductions in water use".[34]

The greatest effects of metering are on non-essential water uses such as lawn sprinkling and car washing; domestic or indoor uses are hardly affected (Table 3-3). Consequently, the greatest impact of metering will be in levelling off the maximum day and peak hour use.

It is apparent from Table 3-3, and from the general literature which supports the results portrayed in that table, that total residential water use is about 30 to 50 percent higher in flat rate areas, with most of the extra demand occurring during seasonal peaks for lawn watering.

An additional, and dramatic example of metering effects is that of Boulder Colorado. In Boulder, Hanke and Flack[35] found that metering resulted in a drop in average annual use of about 80 gpcd (364 lpcd) and a drop in the ratio of summer to winter use of 2.37 in 1960 to 1.93 in 1965. Per capita consumption dropped about 40 percent from 1960 to 1965. As a result, Boulder had the capacity to serve about 11,000 more people with the same water supply. This deferment of expenditure through metering is illustrated in Figure 3-2.

TABLE 3-3

METERED AND UNMETERED RESIDENTIAL WATER USE, WEST UNITED STATES

	Metered and public sewers (10 areas) gpd.	(m^3pd)	Flat rate and public sewers (8 areas) gpd.	(m^3pd)
Domestic use				
Mean annual use	247	(1.1)	236	(1.0)
Mean of maximum day use	454	(2.1)	431	(2.0)
Mean of peak-hour use	1214	(5.5)	1016	(4.6)
Sprinkling use				
Mean annual use	186	(.8)	420	(1.9)
Mean of maximum day use	707	(3.2)	2083	(9.5)
Mean of peak-hour use	2076	(9.4)	4812	(21.9)
Residential use (domestic and sprinkling)				
Mean annual use	458	(2.1)	692	(3.1)
Mean of maximum day use	979	(4.5)	2354	(10.7)
Mean of peak-hour use	2481	(11.3)	5170	(23.5)

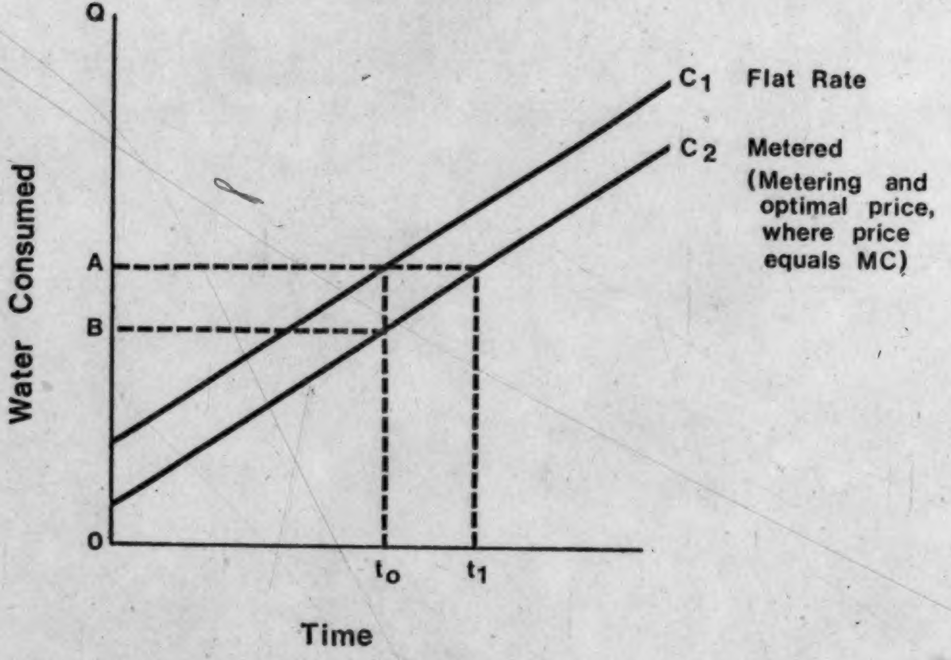
SOURCE: by Grima, p. 51, from F. P. Linaweaver, Jr., J. C. Geyer, and J. B. Wolff, A Study of Residential Water Use (Washington, D.C.: GPO, 1967), Tables 2, 3, and 4.

In a follow-up study in Boulder, Hanke[36] found that the metering effect not only resulted in significant reductions in the amount of water used, but also in increased attention to water leakage, and even a reduction in the area of yard sprinkled.

An argument exists that metering becomes ineffective after the initial impact, and demand rises again. There is little evidence to either support or negate this

FIGURE 3-2

REDUCTION OF CONSUMPTION THROUGH METERING

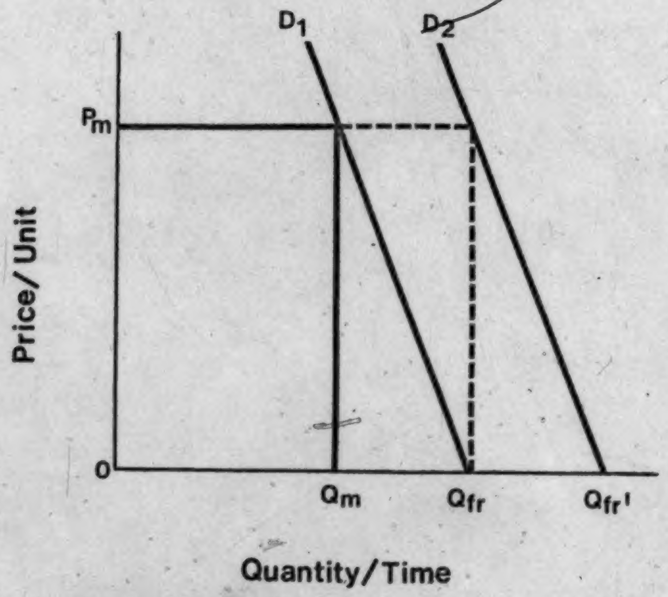


If consumption is OA at t_o, installation of meters would reduce consumption of OB, and yield capacity, BA. No new capacity would be needed until the demand curve shifted and the original consumption level was reached.

argument. However, the likelihood, Hanke and Flack[37] argue, is that population increases, income, and taste will cause the demand curve to shift to the right after a few years. Consequently, more water will be purchased at all alternative prices. Thus, as shown in Figure 3-3, after meters have been installed for say three years, the demand curve will have shifted from Q_m to Q_{fr}. However, if flat rates had been left as the price scheduled, the demand would have been at $Q_{fr'}$.

FIGURE 3-3

EFFECT OF METERING OVER TIME



It seems likely that metering, through encouraging reduced consumption, offers the following savings:[38]

1) variable costs associated with larger facilities are not incurred
2) variable expenses in existing plants may be reduced, because less water has to be treated
3) long run savings in design parameters may be brought about through lower peak to average ratios. A smaller system could therefore be designed, even if average uses remained the same.

Metering, however, is usually only as effective as the price which is attached to it. As with metering alone, the greatest effect of pricing occurs outside the house. For example, response to climatic conditions in respect to lawn watering is much greater when the marginal price of water is zero than when it is positive.

Howe and Linaweaver[39] found that price elasticity is least for indoor use (-0.23), highest for sprinkling use in eastern U.S.A. (-0.9), and about -0.7 for sprinkling in the drier western U.S.A. Hirshleifer et al[40] also arrived at an average elasticity of around -0.4 (which is to say that a 1 percent increase in price will bring about a 0.4 percent decrease in consumption). Hirshleifer, et al[41] calculate that when applied in practise, this means that if the daily peak is about 160 percent of system average demand, and if the price elasticity is -0.4, then a 50 percent summer premium in price would tend to reduce the daily peak to only about 128 percent of system average demand.

Due to the apparent elasticity of demand, price, as noted previously, is also effective in delaying or reducing capacity expansions. This is significant, for if "either the marginal cost of production or the capital cost of construction is increasing with time, these delays or reductions will help hold down the cost of water in the future. If both marginal production costs and capital expansion costs are increasing rapidly, the long run average costs of water could be affected markedly".[42] This argument is also supported by Grima[43], who feels it reasonable to expect about two-thirds of the investment requirements for residential water to be affected by policy changes which reduce the rate of water use per dwelling unit.

It seems likely then, as the U.S. National Water Commission[44] concludes, that the installation of meters and the use of cost-based pricing policies will lead to the more efficient use of present water supplies, plus the deferral of increasingly costly investments for development of new supplies.

RATIONING

Types

Rationing is largely a legislative means of reducing water consumption, although exhortation is often included in this category. The most generally used type of rationing is through the odd-even rule for lawn watering, car washing, and so on, in order to reduce peak loads on a daily basis. Exhortation also enters here, in that radio broadcasts and other media reports can be used to suggest the amount of watering necessary for lawns, and prevent overwatering. Or, rock gardens and other substitutes can be encouraged in place of lawns. Other means of rationing water include reducing water pressure, or even specifying the number and size of fixtures allowed in a house.

When Is Rationing Desirable?

The general consensus in the literature appears to be one of viewing rationing as only a short term solution to shortages. Grima takes this stand, for he feels that "in a country enjoying a high standard of living the diminution of service by means of legal compulsion should be considered a short period palliative rather than a long-term solution".[45] Thus, first priority should be given to metering and the establishment of a rational water rate schedule, because these alternatives do not impose any artificial restrictions on water use. Rationing and other nonprice alternatives become more attractive when the projected marginal price of the water is already high. When this marginal price is high, further increases become progressively less effective. It is also argued by Turnovsky[46] that quite often the change in any of the variables affecting consumption, such as price, may be too substantial to be feasible from the political point of view. In this case, rationing may be the necessary alternative to reduce domestic water use. In fact, Turnovsky feels that "residential demand can probably be best reduced by rationing".[47] Rationing may also be justified when the extra cost of pricing or of meter installation exceeds the savings gained by more rational utilization of water supplies.[48]

Effectives of Rationing

Rationing, by definition, is bound to be effective in reducing both average consumption, and particularly peak demands. In some cases, it may be the most effective means. However, the problem of rationing, both as an economic tool and as an expedient means of reducing demand is perhaps summarized most capably by Hanke and Flack in the following manner:

> efficiency in the allocation of resources requires that the marginal value of the resource be equal for all consumers. The water rationer does not possess information concerning an individual's demand functions; therefore, rationing could not logically lead to an efficient allocation of water. Not only is water inefficiently allocated under rationing, but nobody is satisfied--including the harassed water supplier. If it were not for the consumer's short run "water crises" attitudes, the situation would become intolerable.[49]

Leakage

Leakage is a significant factor in the waste of water in many urban areas. In respect to private facilities, leakage control would be encouraged automatically through the use of a conservation pricing policy.

However, leakage is also a problem of water managers, in that many water systems accept a loss of 20 percent or more of total pumpage as normal, and this is water which has already been through the treatment process. Quite often, these losses are much higher, and the cost of saving the water is usually only a fraction of the cost of obtaining additional supplies.[50]

Moreover, although the ability to detect leaks may be altered somewhat by soil condition, many communities do not have a specific leak detection program. Nor, in many cases, do water plants keep track of the differences between metered sales and metered pumpage in order to determine the approximate amount of leakage. And, there are those communities which, although they do have universal metering, do not meter their own pumps. If the general public is to be expected to practise the efficient use of water, they cannot be expected to pay for water wasted through careless management of distribution systems.

THE USE OF MANAGEMENT ALTERNATIVES IN ALBERTA

To date, very little work has been directed towards documenting, and in particular aggregating, the demand characteristics for residential water in Alberta. Some research on municipal and residential water demand has been undertaken by researchers at the University of Alberta, but this data has not been collated to any great degree or published.[51] Financial information on municipal water systems is published annually by the Department of Municipal Affairs[52], and Alberta Environment[53] has a booklet available on water and sewerage systems in Alberta. Countless individual studies on residential demand have been undertaken for the various municipalities in Alberta by consulting engineers, but no attempts have been made to bring the results of these studies together.

Nevertheless, two theses by Kellow[54] and Ward[55] are available which proved valuable in formulating this study. The research detailed in these theses absorbed the need for detailed study of Alberta's two major cities of Calgary and Edmonton, and provided evidence that water demand characteristics in Alberta could be assumed to be similar to characteristics of water demand in the United States. Ward and Kellow both derived data comparable to the United States on per capita consumption, peak demands, and the relationship between pricing and consumption.

Calgary has both flat rate and metered customers. In 1968, per capita consumption in Calgary for metered customers averaged 68 gpcd (309 lpcd). The consumption rates of flat rate customers, however, averaged 104 gpcd (473 lpcd). For Calgary as a whole, including commercial and industrial use, per capita consumption was 130 gpcd (591 lpcd).[56] All of these figures compare closely with the figures from the United States which were presented previously.

Differences in consumption levels occurred between Calgary and Edmonton, probably due to climatic variations.[57] Overall per capita consumption for Edmonton in 1968 was considerably less than in Calgary, averaging about 84 gpcd (381 lpcd). Residential consumption alone was also considerably lower, with Ward's[58] 1970 figures still averaging only 52.8 gpcd (240 lpcd) in the Hardisty area. This figure could vary, of course, depending upon the type of residential area.

As might be expected, peak demands in Edmonton and Calgary also had similar characteristics to those of American cities. Ward[59] found that summer consumption exceeded winter consumption by approximately 80 percent, and in Calgary[60], summer patterns almost doubled those of average winter consumption. Daily peaks in Calgary[61] were over two times the daily average, and slightly less than two times in Edmonton.[62] These patterns also illustrate the effects of climate on lawn watering, and subsequently on peak demands.

In addition, Kellow[63] found a relationship between consumption and socio-economic class. The ratio of average monthly consumption to average maximum monthly consumption increased from approximately 1:2 for the lowest wealth class he studied to approximately 1:4 for the highest wealth class.

Pricing practices in Alberta are essentially undocumented. Edmonton[64] had a study compiled in which it compared its water and sewage rates with other cities in Canada to see if its rates were competitive. Generally, Edmonton's prices for both residential and industrial water were lower. Comparison was complicated to some extent in that Edmonton collects some money from general revenue and frontage charges and some cities do not, particularly those in Saskatchewan and Ontario.

Calgary[65], in 1968, was still charging reduced summer rates. And, as noted previously, customers in Calgary have had a choice of choosing whether they want to be charged a flat rate or to be metered. Understandably, the ratio is about 1 to 4, metered to flat rate users. Those customers on flat rate also tend to use about 50 percent more water, and pay about the same total amount for it as do metered users for a lesser amount of water.[66] In Edmonton metering is universal.

Finally, it is significant that only 20.1 percent[67] of the water used in Calgary went to commercial and industrial customers. In Edmonton, an estimated 10 to 15 percent goes to industries and suburban towns.[68] This leaves the bulk of the water in both cities subject to the demands characteristic of residential water, and thereby, to the application of the various management alternatives.

SUMMARY

In the preceding pages the rationale behind and the need for rational water policies has been documented with a view to providing the background information and logic which is the basis of this research project. In the following pages, the principles expounded here will be evident in the approach to data collection, and in the basic assumptions on which the analysis is based.

It is recognized that there are many viewpoints as to what rational water policies should be. However, as Gysi[69] notes, few of these viewpoints are backed by more than subjective opinions or motivated desires: the utility manager advocates higher rates in order to provide better service, the politician suggests lower rates for economic growth, and economists proclaim marginal cost pricing as a means of obtaining economic efficiency.

The future, though, seems to point to the need for increased efficiency, with the resultant effects of reduced consumption and lower capital and operating costs for water supply utilities. The critical requirement here is the acceptance of the idea of a consumer demand function as a measure of benefit. It seems correct, as Gysi[70] claims, that the first point has been proven - higher prices and metering induce a reduction in residential purchases. The second problem is one of bringing the utility planner through one big step - convincing him that the requirements approach is not the best one.

FOOTNOTES

[1] Robert D. Hennigan, "Urban (Municipal) Water Management", in Proceedings of the Annual Meeting of the AWRA, 4th (Illinois: AWRA, 1969), p. 717.

[2] Nathaniel Wollman and Gilbert W. Bonem, The Outlook for Water (Baltimore: Johns Hopkins for Resources for the Future, 1971), p. 52.

[3] One American gallon equals approximately 4/5 Imperial gallons. All measurements have been converted to Imperial gallons throughout the thesis.

[4] Angelo P. Grima, Residential Water Demand: Alternative Choices for Management (Toronto: University of Toronto Press, 1972), p. 4. See also Bernd H. Dietrich and J. M. Henderson, Urban Water Supply Conditions and Needs in 75 Developing Countries, World Health Organization Public Health Papers No. 23 (Geneva: WHO, 1963), p. 13.

[5] See Terence R. Lee, Residential Water Demand and Economic Development (Toronto: University of Toronto Press, 1969).

[6] Wynn R. Walker and Gaylord V. Skogerboe, "The Impact of Water Quality Objectives on Urban Water Supply Planning", Water Resources Bulletin, Vol. 9, No. 5, (October, 1973), p. 861 (pgs. 861-873).

[7] Frank J. Quinn, Area of Origin Protectionism in Western Waters, Social Sciences Series #6 (Ottawa: Information Canada, 1973), p. 65.

[8] National Water Commission, Water Policies For The Future, Final Report to the President and to the Congress of the United States (Washington, D.C.: U.S. Government Printing Office, June, 1973), p. 41. See also Wollman and Bonem, p. 4.

[9] Edward Kuiper, Water Resources Development: Planning Engineering, Economics (Toronto: Butterworth, 1967), p. 387.

[10] Kuiper, p. 392.

[11] Hittman and Associates, Inc., Price, Demand, Cost, and Revenues in Urban Water Utilities, HIT 474 (Columbia, Md: Hittman and Associates Inc., 1970). Quoted by National Water Commission, p. 252.

[12] Kuiper, p. 390.

[13] Grima, pp. 15-18.

[14] L. Douglas James and Robert R. Lee, Economics of Water Resources Planning (Toronto: McGraw-Hill, 1971), p. 313.

[15] Charles W. Howe, "Water Pricing in Residential Areas", Journal AWWA, Vol. 64, No. 5 (May, 1968), p. 492.

[16] The situation may arise where marginal cost is lower than average cost. In this case, it is suggested that there should be 2 charges: (1) a fixed charge to cover revenue deficit; and (2) a price based on the incremental cost of the service provided. The two charges should be high enough to fully recover from users all costs of the utility service. The above is taken from National Water Commission, p. 249-251. See also Edna Loehman and Andrew Whinston, "A new theory of pricing and decision making for public investment", Bell Journal of Economics and Management Science, Vol. 2, No. 2 (Autumn, 1971), pp. 606-625.

[17] National Water Commission, p. 247.

[18] National Water Commission, p. 41.

[19] Grima, p. 6.

[20] Marshall Gysi, "The Effect of Price on Long Run Water Supply Benefits", Water Resources Bulletin, Vol. 7, No. 3 (June, 1971), p. 525. (Hereafter referred to as Gysi, June, 1971).

[21] C. W. Howe and F. P. Linaweaver, "The Impact of Price in Residential Water Demand and its Relation to System Design and Price Structure", Water Resources Research,

Vol. 3, No. 1 (1967), p. 16.

[22] J. Ernest Flack, "Meeting Future Water Requirements Through Reallocation", Journal AWWA, Vol. 59, No. 11 (1967), p. 1341.

[23] J. B. Wolff, "Peak Demands in Residential Areas", Journal AWWA (October, 1961), p. 1251.

[24] System design and capacity can be complicated considerably by the problem of fire protection, particularly in terms of getting the best insurance grading. This is particularly so in small communities, where fire requirements may be several times daily use requirements. For a complete discussion of this problem, see Robert L. Greene, Guidelines for Investment and Pricing Decisions for Municipally Owned Water Utilities, Public Finance Monograph Series No. 2 (Georgia: College of Business Administration, University of Georgia, 1970), Chapter 2.

[25] Grima, p. 136.

[26] National Water Commission, P. 254. It should be noted that while water officials are often elected in the United States, they are usually appointed in Canada. It is possible, then, that water utilities in Canada are insulated to a greater degree from political pressure than are American utilities. For an analysis of political influence on decisions relating to residential water charges in the United States, see Patrick Mann, "The Political Influence of Residential Consumers on Water Rates", Water Resources Bulletin, Vol. 9, No. 5 (October, 1973), p. 977.

[27] Marshall Gysi, "Flexible Pricing in Water Supply Planning - For Flexible Engineers", Water Resources Bulletin, Vol. 8 #5 (October, 1972), p. 964. (Hereafter referred to as Gysi, Oct., 1972).

[28] Marshall Gysi, The Long Run Effects of Water Pricing Policies (New York: Cornell University, 1971), p. 310. (Hereafter referred to as Gysi, 1971).

[29] Gysi, June, 1971, p. 523.

[30] Gysi, June, 1971, p. 523.

[31] Gysi, 1971, p. 29.

[32] Gysi, 1971, p. 51

[33] Jack Hirshleifer, James C. DeHaven, and Jerome W. Milliman, Water Supply: Economics, Technology and Policy (Toronto: University of Toronto Press, 1969), p. 41, Hereafter referred to as Hirshleifer, et al.

[34] National Water Commission, p. 252.

[35] Steve H. Hanke and J. Ernest Flack, "Effects of Metering Urban Water", Journal AWWA, Vol. 60, #12 (1968), p. 1364.

[36] Steve H. Hanke, "Some Behavioural Characteristics Associated With Residential Price Charges", Water Resources Research (Oct. 1970), pp. 1383-1386.

[37] Hanke and Flack, p. 1363.

[38] Hanke and Flack, p. 1365.

[39] Howe and Linaweaver, pp. 21-23.

[40] Hirshleifer, et al, p. 103.

[41] Hirshleifer, et al, p. 112.

[42] Gysi, 1971, p. 310.

[43] Grima, p. 156.

[44] National Water Commission, p. 253.

[45] Grima, p. 6.

[46] Stephen J. Turnovsky, "The Demand for Water: Some Empirical Evidence on Consumers' Response to a Commodity Uncertain in Supply", Water Resources Research, Vol. 5, #2 (April, 1969), p. 360.

[47] Turnovsky, p. 360.

[48] Hirshleifer, et al, p. 112.

[49] Hanke & Flack, p. 1361.

[50] Homer E. Beckwith, "Economics of Leak Surveys", Journal AWWA, Vol. 56, #5 (1964), pp. 575-576.

[51] Data have been collected by Ian MacIver, formerly of the Department of Geography, University of Alberta in a questionnaire entitled "Municipal Water Supply Questionnaire", administered in 1970. Data have also been collected by W. W. Schultz, of the Department of Agricultural Economics in a questionnaire entitled "Residential Water Use Study: An Inventory of Public Water Distribution Systems", which was administered in July, 1968. This information is also available from the Environmental Demand and Problem Analysis Branch, Planning Division, Alberta Department of the Environment.

[52] Department of Municipal Affairs, Province of Alberta Municipal Statistics for year ended December 31, 1971 (Edmonton: Queen's Printer, 1973).

[53] Alberta Department of the Environment, Alberta Waterworks, Sewerage and Swimming Pools Survey, 1971 (Edmonton: Government of Alberta, 1972).

[54] Richard L. Kellow, A Study of Residential Water Use in Calgary (Edmonton, Alberta: Unpublished Masters Thesis, Department of Agricultural Economics and Rural Sociology, University of Alberta, Spring, 1970).

[55] Edward N. Ward, Residential Water Use in the Hardisty District, Edmonton, Alberta (Edmonton, Alberta: Unpublished Masters Thesis, Department of Geography, University of Alberta, 1971).

[56] Kellow, p. 72.

[57] For example, Kellow found that the demand curve pattern for residential water in Calgary was closely associated with the pattern of moisture deficits, Kellow, p. 85-86.

[58] Ward, p. 66.

[59] Ward, p. 81.

[60] Kellow, p. 82.

[61] Kellow, p. 89.

[62] Ward, p. 81.

[63] Kellow, p. 92.

[64] Maurice Casey, Comparison Study of Water and Sewage Rates of Major Canadian Cities, 1972 (Xerox, City of Edmonton) 8 pages.

[65] Kellow, p. 82.

[66] Kellow, p. 5.

[67] Kellow, p. 5.

[68] Casey, p. 2.

[69] Gysi, 1971, p. 3.

[70] Gysi, 1971, p. 307.

CHAPTER 4

OBJECTIVES AND RESEARCH METHODOLOGY

SPECIFIC OBJECTIVES

The basic objective in this thesis, as was outlined in the introductory chapter, is to determine the implications of managerial perceptions and attitudes to the use of management alternatives in residential water supply. Based upon the preceding review of perception studies in geography, the use of management alternatives in residential water supply, and upon the preliminary review of available data, three areas which require investigation become evident. These three general areas are: (1) a survey of water supply and demand characteristics in Alberta; (2) a survey of the perceptions and attitudes of residential water managers in Alberta as they relate to management alternatives; and (3) the relationship between the managers' experiences in residential water management and their attitudes toward management alternatives. Primarily, the first objective is one of physical inventory. The second objective relates to an overall view of management attitudes. The third objective represents an exploration of the relationships between environment and behaviour.

Within each one of these general objectives, more specific objectives may be defined as listed below:

1. Water Supply and Demand Characteristics in Alberta
    (a) To collect the necessary factual information on water demand characteristics, water supply problems, and the use of management alternatives.
    (b) To determine whether or not the characteristics of demand in Alberta generally warrant the use or consideration of use of management alternatives.
    (c) To determine whether or not demand characteristics coincide with the generalities expressed in the literature and thereby corroborate the nomothetic nature of the study.
2. Perceptions and Attitudes of Water Managers in Alberta
    (a) To determine the perceptions and attitudes of water managers in Alberta as these perceptions and attitudes relate to the use of management alternatives, to their role as water managers, and to their general attitudes towards water supply and water conservation in a residential setting.
    (b) To determine whether or not managerial perceptions coincide with the generalities expressed in the literature, and thereby

corroborate the nomothetic nature of the study.

3. The Relationship Between Managerial Experiences and Attitudes.

   (a) To determine what role perceptions and attitudes play in the choice of and use of management alternatives.

   (b) To gain an understanding of the factors underlying the perceptions and attitudes of water managers.

RESEARCH METHODOLOGY

Methodological Approach

In view of the fact that the research objectives involved the collection of data on water demand from the individual communities, as well as the collection of data on the perceptions and attitudes of individual water managers, the approach to data collection necessarily became that of a questionnaire survey. There were simply no existing sources of data with which to document either the physical or behavioural components of the study. Moreover, due to the spatial distribution of the municipalities under study, and the fact that the physical component of the study required the retrieval of data from municipal files, the time, cost, and logistics constraints further narrowed down the alternatives to that of a postal questionnaire.

The Sample

The choice of a sample was complicated to some extent by the dichotomous nature of the data to be collected. In terms of the physical component of the study, the more complete the inventory, the greater the utility which may be derived from it. However, in terms of the behavioural component, all that would be required in order to make inferences about perceptions, attitudes, and behaviour is a random sample of water managers. In fact, to increase the amenability of the data to the application of inferential statistics, this would be desirable.

The above problem was solved by treating Alberta as a cluster sample, and therefore applying the questionnaire to 100 per cent of the sample. The implications of this approach will be discussed later in this chapter within the section on "Use of Statistical Tests".

The sample to which the postal questionnaire was sent consisted of all managers of public water supply systems in Alberta. Only public systems were used in order to maintain reliability in the data.

Sample Frame

No listings were available of communities in Alberta with public water supply systems and who was chiefly responsible for them. Thus, the listing of communities with water supply systems was taken from the Alberta Waterworks Sewerage and Swimming Pool Survey, 1971,[1] published by Alberta Environment. A check was made with

Alberta Environment to determine if additions to the list had been made since 1971. For purposes of the sample, all of the communities in this list were assumed to have public systems. The names of the municipal secretaries for these communities were then taken from a list of chief officials of all municipalities in Alberta distributed by the Department of Municipal Affairs.[2]

For hamlets, which are governed by the County or Municipal District, the municipal secretary of the relevant county or district was selected. Several communities in Improvement Districts with systems which were not listed in the Alberta Environment survey were obtained from the Department of Municipal Affairs.[3]

Using the above sampling frame, a total of 253 communities was selected. Since some of the counties or districts had two or more hamlets, one hamlet was randomly selected from each county, leaving a sample of 242 communities. However, ten of these communities were later found to have either no system or a privately owned system. The final sample size was thus reduced to 232.

Administration of the Questionnaire

In order to test the questionnaire for clarity, relevance of questions, and response rate, a pilot study was undertaken before mailing the final questionnaire. Eighteen communities of all sizes were selected, and a questionnaire was mailed to them on June 22, 1973. Approximately 50 percent of these were returned within three weeks (Table 4-1).

With the 18 pilot communities subtracted, the final 214 questionnaires were mailed on July 17, 1973. All of the questionnaires were mailed to the municipal secretaries of the respective communities, with a request that the questionnaire be forwarded to the appropriate person if they themselves were not responsible for management of the water system.

The rate of return remained constant until the end of August. On September 7, 1973, a reminder was sent to all nonrespondents including those nonrespondents remaining from the pilot study. On October 18, 1973, a second and final reminder accompanied by a second copy of the questionnaire was mailed to all remaining communities, asking that the questionnaire be returned before November 9, 1973. The effectiveness of the reminders, and the return rate for the various levels of municipalities are shown in Table 4-2. The overall response rate for the final questionnaire was 71 percent, and 83 percent for the pilot questionnaire. With the two questionnaires combined, the total rate of response was 72 percent, providing 168 usable questionnaires. Eight additional questionnaires arrived too late to be of use. Altogether, the 168 communities which responded represented a total of 1,217,092 Albertans, or 95 percent of all Albertans dependent upon a public water supply system.

TABLE 4-1

RESPONSE RATES TO PILOT QUESTIONNAIRE

	NUMBER MAILED	INITIAL NUMBER RETURNED	NUMBER RETURNED AFTER REMINDER	TOTAL RETURNED	PERCENT OF TOTAL RETURNED
Cities	1	1	-	1	100
Towns	9	5	4	9	100
Villages	8	3	2	5	63
Hamlets	-	-	-	-	-
TOTALS	18	9 (50%)	6 (33%)	15	83

TABLE 4-2

RESPONSE RATES TO FINAL QUESTIONNAIRE

	NUMBER MAILED	INITIAL NUMBER RETURNED	NO. RETURNED AFTER 1ST REMINDER	NO. RETURNED AFTER SECOND REMINDER	TOTAL NO. RETURNED	NO. RETURNED AS PERCENTAGES OF NUMBER MAILED
Cities	9	6	1	1	8	89
Towns	90	37	15	13	65	72
Villages	103	50	14	8	72	70
Hamlets	12	7	1	-	8	67
TOTALS	214	100 (47%)	31 (14%)	22 (10%)	153	71

Measurement of Attitudes

It was argued in Chapter 2 that attitudes provide the measurable component for studies in behavioural geography. However, while attitudes as theoretical constructs are fine, the operational part of measurement is still subject to methodological problems. Many of these problems stem from the fact that it is verbal behaviour which is being measured, and people are often reluctant to reveal their attitudes, or have difficulty in revealing them. Furthermore, the characteristics of attitudes also make the measurement of both direction and intensity possible, although operationally difficult. The problem is to use a technique which will provide both valid and reliable data, but which at the same time can be constructed with relative ease.

One technique which has proven successful in quantitatively measuring attitudes and differentiating between them, and which has been adapted to behavioural geography, is that of attitude scaling.[4] The particular scaling technique which has been adapted for this research project is a modified version of the "Likert-type summated scale",[5] which provides a number of statements about the attitude object and a series of response alternatives ranging from strongly disagree to strongly agree. The Likert scale, which is recommended by Schiff,[6] provides data at an ordinal level. This level of data allows the ranking of individuals according to the relative degree of favour or disfavour of their attitudes toward a given object.

The procedure is modified here, for accurate use of the Likert scale requires that it be administered to a group representative of the population on whom the scale is to be used in order to remove any statements which do not correlate with the overall attitude score. This requires several tests of the scale, using different panels of subjects, and is both time-consuming and expensive. Therefore, a modified version of the Likert format was used in that total attitude scores were not attempted, and the statements used in the scales were based on the literature, and on a limited number of interviews with government personnel. This version of the Likert scale will still provide an ordinal level of data, and allow for the testing of differences between groups on individual statements.

The Questionnaire

Whereas the problems of questionnaire design are beyond the scope of this paper, a brief discussion of some aspects of the questionnaire may help to make the next three chapters on analysis more meaningful. The two components of the research project are reflected in the design of the questionnaire. Section 1 is concerned largely with the physical characteristics of water supply and demand, pricing schedules, and so forth. Section 2 of the questionnaire was directed towards the perceptions and attitudes of the water managers. A short third section was included so that profile data on the water managers, and additional comments might be obtained. A copy of the questionnaire is included as Appendix A.

The utility of the various questions should be evident in the analysis. Most of the questions were "closed" for purposes of shortening the time required to answer the questionnaire. Internal checks for consistency were used as much as possible, but again, length of the questionnaire precluded an indepth analysis of all aspects touched upon in the study.

The questionnaire was distributed in booklet form, and a covering letter explaining the purpose of the questionnaire was included as a matter of course. An additional letter from the Planning Division of the Alberta Department of the Environment was also included, indicating the Department's interest in the project, and thereby adding to the credability of the research as being worthwhile (Appendix B). While the value of the letter can only be guessed at, it need only be noted that a response rate of 72 percent for a 23 page questionnaire is well above average.[8]

The questionnaire was pretested in the pilot study described previously. In the pilot study, a statified sample was used, and the questionnaire appeared to be readily understood by and relevant to the managers of water systems in cities, towns and villages. Based on the pilot study, some minor changes in wording were made to the questionnaire, and several additional questions were added for clarity. Although the pilot survey was small, the results did indicate that the statements in the Likert scale were also relevant.

Statistical Analysis

The data collected in behavioural studies such as this are amenable only to those kinds of statistical tests which fall under the classification of nonparametric statistics.[9] Nonparametric, or inferential statistics, deal with small portions or samples of populations, and are subject to few assumptions: independence of data, and sometimes an underlying continuous distribution.[10] The few assumptions which are required render nonparametric statistics appropriate to behavioural research in which only ordinal level data are achieved, and inferences of a nomothetic nature are drawn concerning the perceptions and attitudes of respondents other than those sampled.

The data collected in this study appear to meet the requirements for nonparametric statistical analysis. Although the nonrandom choice of Alberta results in not all of the assumptions of cluster sampling being met, it should not logically bias the results of the analysis. It should be noted, however, that it is argued (although undocumented) that cluster sampling may not be as reliable as the simple random sample.[11]

Independence of data has been achieved within the sample. The requirement of independence is met when "the observations are taken in such a way that each stands an equal chance of being chosen".[12] Thus, it would seem that the application of statistical analysis to the data collected in the project will produce valid results. In any case, the results of the analysis may be judged under the scrutiny of the above assumptions.

The main statistical test which will be used is the chi-square test.[13] A nonparametric test, it is particularly useful for identifying significant between group differences in values, opinions, perceptions, and attitudes. The test may be used with only nominal data, and can be used to measure a large number of groups. Essentially, when testing for differences between two independent samples, the test is used to identify significant differences between the proportions of one group in various categories and the proportions of a second group in the same categories.

FOOTNOTES

[1] Alberta Department of the Environment, *Alberta Waterworks, Sewerage, and Swimming Pool Survey, 1971* (Edmonton: Government of Alberta, January, 1972).

[2] Municipal Inspection Branch, Department of Municipal Affairs, *Alberta Municipalities, Urban and Rural, Including the Chief Officials of all Cities, Towns, Villages, Counties and Municipal Districts* (Edmonton: Alberta Department of Municipal Affairs, 1973). Xerox.

[3] These community names were obtained from communications with J. Neil Gibson, Field Service Branch, Alberta Department of Municipal Affairs, Edmonton, Alberta.

[4] For a complete discussion of attitude scales, see C. Seltiz, *et al*, "Attitude Scaling", in *Attitudes*, ed. Marie Jahoda and Neil Warren (Great Britain: Penguin Books, 1966), Chapter 26. See also Harry S. Upshaw, "Attitude Measurement", in *Methodology in Social Research*, ed. Hubert M. Blalock, Jr., and Ann B. Blalock (Toronto: McGraw-Hill, 1968). pp. 60-111.

[5] C. Seltiz, et al, p. 315.

[6] Myra R. Schiff, Some Theoretical Aspects of Attitudes and Perceptions, Natural Hazard Research Working Paper No. 15 (Toronto: University of Toronto), p. 17.

[7] The rationale on which the questionnaire design is based was taken largely from T. L. Burton and G. E. Cherry, Social Research Techniques For Planners (London: George, Allen, & Unwin, 1970), and from A. N. Oppenheim, Questionnaire Design and Attitude Measurement, (New York: Basic Books, 1966).

[8] Experience with postal questionnaires by many disciplines has indicated that response rates of 30 to 50 percent are average for postal questionnaires; see Burton and Cherry, p. 39.

[9] The other classification of statistical tests is that of "parametric" statistics. Parametric statistics deal with whole populations, and are subject to more rigorous assumptions than are nonparametric statistics. For a detailed discussion of the difference between the two types of statistics, see Sidney Siegel, Nonparametric Statistics for the Behavioural Sciences (Toronto: McGraw-Hill, 1956), p. 19.

[10] Siegel, p. 21.

[11] For a discussion of cluster sampling, see John E. Freund, Modern Elementary Statistics (New Jersey: Prentice-Hall, 1967), p. 195-196. For a more complex discussion, see Bernard Lazerwitz, "Sampling Theory and Procedures", in Methodology in Social Research, pp. 298-308.

[12] Peter Gould, "Is Statistix Inferens the Geographical Name for a Wild Goose", Economic Geography, Vol. 46, No. 2 (Supplement, June, 1970), p. 441.

[13] For a complete discussion of the chi-square test, see Siegel, p. 42-47 for the one sample test, and Siegel, pp. 104-111 for the two sample test.

CHAPTER 5

CHARACTERISTICS OF WATER SUPPLY AND DEMAND IN ALBERTA

Of the three general areas under consideration, the following analysis represents the "physical inventory" portion of the research. The characteristics of water supply, water demand, and the use of pricing, metering, and rationing will be considered. To save repetition in the forthcoming discussion, it should be noted that the results of the following analysis are based upon the sample of communities described in the preceding chapter, and the percentages and figures expressed are of that sample.

WATER SUPPLY

Source

Approximately one half of the communities in Alberta are dependent upon ground water, and close to one quarter upon rivers or creeks (Table 5-1). The remainder obtain their municipal supplies from other types of surface water, through purchases from other municipalities, or through combinations of sources. The only large regional water distribution system is that of Edmonton, which provides services to St. Albert, Leduc, Spruce Grove, Stony Plain, Fort Saskatchewan, Redwater, Sherwood Park, parts of the Counties of Strathcona, Sturgeon, Thorhild, Leduc and Parkland, Namao, and the International Airport.

TABLE 5-1

SOURCES OF WATER SUPPLY FOR ALBERTA COMMUNITIES

Source	Number	Percent
Purchased	12	7.1
Ground Water	79	47.0
River or creek	40	23.8
Lake or pond	16	9.5
Dugout	8	4.8
Other	6	3.6
Purchased and ground water	1	0.6
Purchased and river or creek	3	1.8
Ground water and river or creek	2	1.2
Ground water, river or creek, and lake or pond	1	0.6
	168	100.0

Although 47 percent of the communities which were sampled use ground water, and 38 percent surface water, the greatest proportion of Alberta's population (88 percent) is dependent upon surface water, and is therefore liable to suffer the vagaries inherent in the stochastic nature of this source

(Table 5-2). However, the distribution illustrated in Table 5-2 is distorted by the fact that the water supplies of both Edmonton and Calgary are obtained from rivers, and therefore only two main sources affect the majority of the province's population. A large portion of the communities in the "pur-chased" category are also dependent upon river water, since they are tied into Edmonton's system.

TABLE 5-2

NUMBER OF ALBERTANS DEPENDENT UPON
VARIOUS SOURCES OF WATER, 1972

Source	Number	Percent
Purchased	52,478	4
Ground water	72,310	6
Surface water	1,065,419	88
Combinations of above	26,885	2
	1,217,092	100.0

The source of water supply in Alberta appears to be related to the size of the municipality and subject to regional variation. Smaller communities generally tend to rely on ground water (Table 5-3). This tendency probably arises from the less expensive supplies usually provided by ground water, plus the fact that ground water supplies in Alberta may not meet the demands of larger municipalities. Surface water also plays a greater role in supply in the southern and northern portions of the province than in the central areas (Table 5-4).

TABLE 5-3

POPULATION OF ALBERTA COMMUNITIES BY SOURCE OF WATER SUPPLY, 1972

	Source	
Population	Ground Water	Surface Water
0 - 500	42	21
501 - 1000	17	9
1001 - 2000	10	13
2001 - 5000	10	12
5001 +	-	9
	79	64

Chi-square significant at .05

TABLE 5-4

NUMBER OF ALBERTA COMMUNITIES IN EACH RIVER BASIN BY SOURCE OF WATER SUPPLY

	Source	
River Basin	Ground Water	Surface Water
South Saskatchewan	8	20
Red Deer	25	5
North Saskatchewan	38	18
Peace/Athabasca	8	21
	79	64

Chi-square significant at .001

Water Quality

Problems of water quality related to residential use in Alberta are minimal. Over 65 percent of the respondents described their water quality as very good to good (Table 5-5). The quality of the water appears to be related to source, in that the managers of those communities with ground water tended to describe their water supply in terms of higher quality (Table 5-6). The above relationship between water source and water quality may explain why the South Saskatchewan and Peace/Athabasca river basins which have the greatest dependency on surface water have a tendency to have the most problems with water quality (Table 5-7). These quality problems are caused in part by deficiency problems which stem from the reliance on surface water.

TABLE 5-5

WATER MANAGERS' PERCEPTION OF THEIR COMMUNITIES' QUALITY OF WATER SUPPLY IN ALBERTA

	Number	Percent
Very Good, No Treatment	56	33.7
Good	52	31.3
Fair	42	25.3
Poor	13	7.8
Very Poor	3	1.8
	166	100.0

TABLE 5-6

WATER MANAGERS' PERCEPTION OF THE QUALITY OF THE WATER SUPPLY BY SOURCE IN ALBERTA COMMUNITIES

	Quality			
Source	Very Good	Good	Fair	Poor
Ground Water	43	21	11	3
Surface Water	3	27	24	9

Chi-square significant at .001

TABLE 5-7

WATER MANAGERS' PERCEPTION OF THE QUALITY OF WATER SUPPLY BY RIVER BASINS IN ALBERTA

	Quality			
River Basin	Very Good	Good	Fair	Poor
South Saskatchewan	7	13	12	4
Red Deer	15	11	5	2
North Saskatchewan	30	17	16	2
Peace/Athabasca	4	11	9	7

Chi-square significant at .01

Shortages

Of the water managers who responded to the questionnaire, 40 percent reported that their communities had suffered shortages within the past five years. The major cause of shortages was the inability of plant facilities to accommodate the demand (Table 5-8). This failure is related to peaking characteristics, and will be discussed further in the next section of this chapter. A list of those communities suffering shortages is included in Appendix B.

TABLE 5-8

FACTORS CAUSING WATER SHORTAGES
IN ALBERTA COMMUNITES

	Number	Percent
Actual Shortage	17	25.8
Inadequate Plant Facilities	33	50.0
Actual Shortage and Inadequate Plant Facilities	2	3.0
Other	14	21.2
	66	100.0

Seventy-three percent of the respondents reported that the shortages suffered by them occurred during the summer, and 30 percent of the reported shortages lasted for a large part of the summer (or winter). Twenty-five percent of the shortages occurred only during the peak days, and 4.6 percent during peak hours. Future shortages are foreseen by 48 of the respondents. It was predicted by these respondents that the shortages would be caused by actual water shortages, limitations of plant facilities, and various other reasons, particularly inadequate storage (Table 5-9).

The propensity of many communities to suffer shortages during peak periods is suggested by the percentage of the maximum capacity which is presently being used on peak days, and the proportion of communities in which consumption increased to over 90 percent of capacity from 1971 to 1972 (Table 5-10). The results portrayed in Table 5-10 are incomplete to the extent that the water managers in the majority of communities are unaware of either one or both of maximum daily pumpage and maximum capacity.

TABLE 5-9

FACTORS PREDICTED TO CAUSE FUTURE WATER SHORTAGES IN ALBERTA

	Number	Percent
Actual Shortage	14	29.2
Inadequate Plant Facilities	20	41.7
Actual Shortage and Inadequate Plant Facilities	4	8.3
Other	10	20.8
	48	100.0

The responses provided by the water managers indicate that all communities, except for four, have some storage capacity. The data are incomplete in this area, but it appears

TABLE 5-10

PERCENTAGE DISTRIBUTION OF ALBERTA COMMUNITIES BY AMOUNT OF MAXIMUM CAPACITY USED ON PEAK DAYS

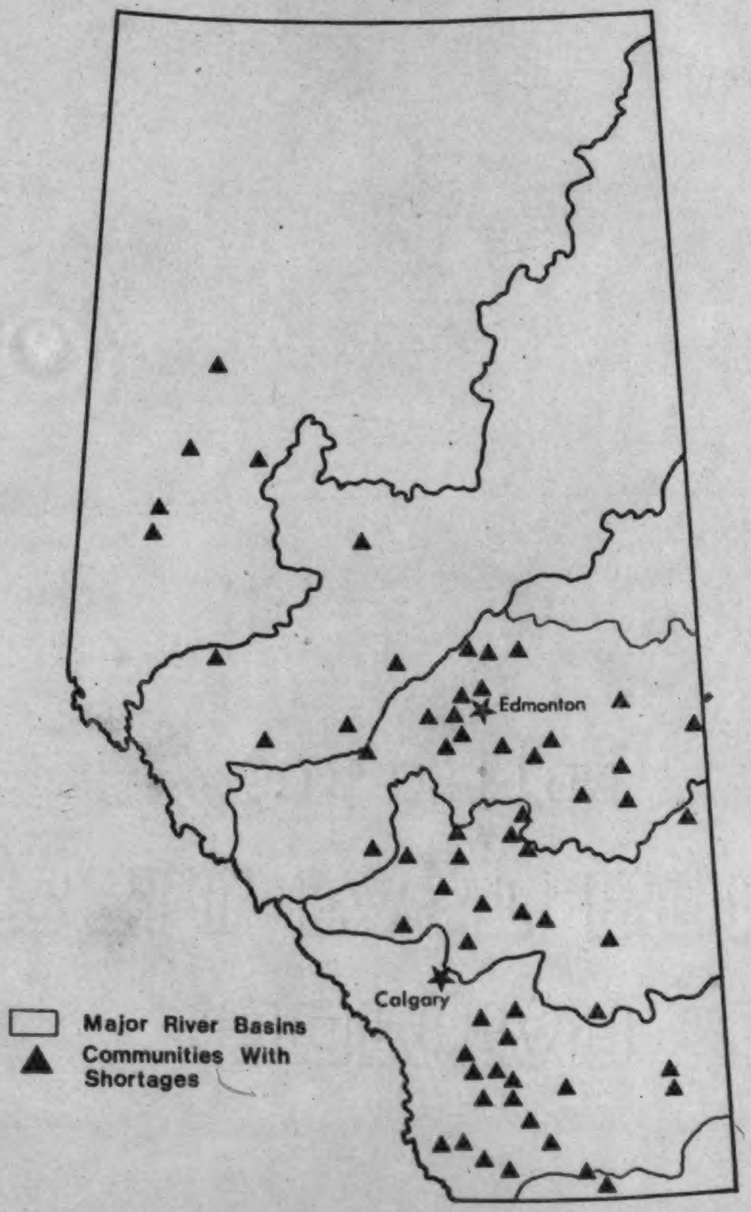
	Percentage Used							
Year	0-50	51-75	76-80	81-85	86-90	91-95	96-99	100
1972	13.6	27.1	8.5	8.5	11.9	10.2	11.9	8.5
1971	11.1	40.1	9.3	7.4	11.1	5.6	3.7	11.1

that storage is adequate for most communities, except in those suffering shortages. Thirteen percent of the respondents also have fire reserve problems, mainly stemming from storage inadequacies.

Shortages are not a problem peculiar to any particular size of community, but there does appear to be some regional variation. There is a greater tendency for shortages to occur in the South Saskatchewan river basin than in other areas of the province (Table 5-11). This, again, is probably due to a combination of peak demand characteristics and water scarcity, and will be examined in greater detail in the next section on "water demand". The spatial distribution of communities in which shortages were reported is portrayed on Map 5-1.

Water Supply and Sewerage

It has been argued in previous chapters of this thesis that efficient management of the demand for water can


Edmonton
Calgary
Major River Basins
Communities With Shortages

Map 5-1 Spatial Distribution of Residential Water Shortages, Alberta, 1968–1972

TABLE 5-11

FREQUENCY OF WATER SHORTAGES BY RIVER BASINS IN ALBERTA

	Shortages	
River Basin	Occurred	Did Not Occur
South Saskatchewan	22	14
Red Deer	13	20
North Saskatchewan	22	45
Peace/Athabasca	9	22
	66	101

Chi-square significant at .05

reap benefits through savings in sewage treatment costs. Moreover, since institutional responsibility results in different attitudes, in terms of whether or not sewage would be considered part of a water supply problem, it would seem beneficial to have water and sewerage responsibility within the same department.

In Alberta, 63 percent of the communities have the sewerage department as part of the water supply department. This situation may stem from staffing problems in smaller municipalities; for, unfortunately, the two departments tend to separate as the communities become larger (Table 5-12).

Including the sewage bill with the water bill can

TABLE 5-12

STATUS OF ALBERTA MUNICIPALITIES BY RELATIONSHIP BETWEEN WATER AND SEWAGE DEPARTMENTS

	Water and Sewer in	
Status	Same Departments	Separate Departments
Cities	4	5
Towns	38	32
Villages/Hamlets	60	22
	102	59

Chi-square significant at .05

Including the sewage bill with the water bill can also be an added inducement to consumers to save water, particularly if the amount of the sewage bill is based on the quantity of water used. Regrettably, no information was collected on whether the average charge is a flat rate or is based on the quantity of water consumed. Data were collected, though, on the means of presenting the sewage bill in order to determine if the mechanism presently exists for this method of charging. This approach is only useful, of course, if the water is metered. Of the 101 communities which do meter, 57 do include the sewage charge in the total water bill, 22 send the sewage bill along with the waterbill, and 22 send the sewage bill entirely separately. Thus, the logistics of sending the bills together if the charges were interdependent could be easily handled by most communities, and the public in the majority of communities are used to paying the two bills together.

Expansions

In eighty communities (or 48 percent of the sample) expansions of the water supply systems have been undertaken within the past five years. These expansions included increased treatment capacity, the development of new sources, more pumps, storage facilities, and in about six percent of the cases, the installation of meters. Forty-five percent of the 80 municipalities undertook expansions in two or more of the above areas. Ninety-one percent of the expansions were purely capacity increases and 50 percent of all expansions afforded excess capacity. As might be expected, the majority of the expansions took place in the cities and towns (Table 5-13).

TABLE 5-13

MUNICIPAL STATUS OF ALBERTA COMMUNITIES WHICH HAVE UNDERTAKEN EXPANSIONS

Status	Have Expanded	Have Not Expanded
Cities	8	1
Towns	46	28
Villages/Hamlets	24	53
	78	82

Chi-square significant at .001

A study of alternatives was undertaken in 62 percent of the communities prior to initiation of an expansion. However, these studies were usually only directed towards the most economic means of increasing the supply, and only 6 percent of those communities in which facilities were expanded considered the use of management alternatives, and in most cases, that was in the form of metering.

Future expansions are being planned by 38 percent of the responding communities. And, as in the case of those communities in which expansions have taken place, a significantly higher proportion of those communities planning future expansions belong to the higher population groups as measured by both population and municipal status. It is also interesting to note that of the communities planning expansions only 13 percent had yet done a study to determine the cost of alternatives.

Leakage

The actual amounts of water lost through leakage can only be calculated accurately by noting the difference between metered sales and pumpage. This requires both universal metering and the metering of pumps. In Alberta, few municipalities are aware of the amount of water lost through leakage, while the remainder claim remarkably small losses (Table 5-14). Of the 24 respondents who profess no leakage though, only eight of them represent communities which are metered.

TABLE 5-14

PERCENTAGE OF TOTAL WATER SUPPLIED WHICH IS LOST THROUGH LEAKAGE IN ALBERTA COMMUNITIES, 1972

Percent Leakage of Total Pumpage	Number	Percent
None	24	14.3
1-5	9	5.4
6-10	2	1.2
11+	4	2.4
Unknown	125	76.6
	164	100.0

Forty-seven percent of the managers reported that a leak detection program is not conducted in their communities. Twenty-eight percent have established programs to control leakage in their own mains, and 25 percent attempt to control leakage in both their own and in private facilities. The presence of a leak detection program is not influenced by size of community, or even by the occurrence of water shortages.

Profit and Loss

Although water supply utilities will receive funds from general revenues if they suffer a loss, it is interesting to note how many are self-supporting, and how many actually contribute to general revenues. Of 130 respondents, 41.5 percent reported a profit in 1972, and 40.8 percent a loss. The remaining number indicated that they broke even. Although the majority of the communities had relatively small profits or losses, some were large (Table 5-15). The reasons for the large losses often stemmed from the problem of repaying previous expansions.

TABLE 5-15

PERCENTAGE DISTRIBUTION OF ALBERTA COMMUNITIES BY AMOUNT OF PROFIT OR LOSS SHOWN BY THEIR WATER SUPPLY UTILITIES, 1972

	Amount (1000's of dollars)					Number of Observations
	1-2	3-5	6-10	11-20	21+	
Profit	45.5	11.4	22.7	13.6	6.8	44
Loss	32.6	30.2	16.3	14.0	7.0	43

WATER DEMAND

Per Capita Demand

Perhaps the most useful index for describing the demand for residential water is in terms of gallons per capita per day (gpcd). However, of the data available for the 168 communities represented in the response to the questionnaire, only a sufficient amount of data could be provided to calculate the average per capita consumption per day in 1972 in 58 percent of the communities; in 1971 for 50 percent; and in 1969, for 47 percent (Table 5-16).

TABLE 5-16

PERCENTAGE DISTRIBUTION OF ALBERTA COMMUNITIES BY PER CAPITA CONSUMPTION PER DAY

Year	gpcd (*ℓpcd*)							
	0-50 *0-227*	51-75 *228-340*	76-100 *341-455*	101-125 *456-568*	126-150 *569-681*	151-175 *682-796*	176-200 *797-909*	201+ *910+*
1972	26.5	36.7	15.3	10.2	3.1	1.0	4.1	3.1
1971	28.9	34.9	15.7	7.2	4.8	1.2	3.6	3.6
1969	39.2	25.3	13.9	6.3	7.6	3.8	1.3	2.5
Without Effects of Industry, 1972								
	27.6	37.3	15.3	10.2	2.0	1.0	3.1	3.1

The figures in Table 5-16 are distorted slightly in that many of the communities are almost purely residential, while some of the larger ones sell considerable amounts of water to industry. Thus, a distribution for 1972 similar to that in Table 5-16 was calculated, except with the amounts used by industry subtracted. For comparative purposes, this breakdown is included in Table 5-16.

Although the breakdown by community provided in Table 5-16 indicates that average daily consumption in a large number of the communities falls in the 51 gpcd to 75 gpcd (232 lpcd to 341 lpcd) range, actual average per capita consumption per day in the province is somewhat higher. The data obtained for 1966 and 1967 indicate average consumption was about 75.5 gpcd (343 lpcd) and 73.3 gpcd (333 lpcd) respectively. By 1969 this had increased to 100.2 gpcd (455 lpcd). And, for 1971 and 1972, the figures are 92.7 gpcd (421 lpcd) and 119.3 gpcd (542 lpcd) respectively.

Also evident from the above distributions of per capita consumption is the fact that Alberta communities do not provide a great amount of industrial water through their municipal systems (Table 5-17). It may be assumed, then, that the majority of demand characteristics, such as peaking, do stem from residential water demand. However, Table 5-17 contains a listing of only the amount of water used by large water using industries in some of the cities and towns. Actual industrial use may be somewhat higher.

TABLE 5-17

PERCENTAGE OF TOTAL MUNICIPAL PUMPAGE SOLD TO LARGE WATER USING INDUSTRIES IN ALBERTA

Cities	Percentage Sold
Calgary	5.8
Edmonton	9.7
Lethbridge	25.9
Lloydminster	1.4
Medicine Hat	10.6
Red Deer	18.4
Wetaskwin	8.5
Towns	
Brooks	3.4
Drayton Valley	0.5
Olds	0.4
Peace River	0.1
Ponoka	0.2
Redcliff	2.3
Redwater	65.1
Stettler	0.2
St. Paul	0.7
Taber	36.8
Vauxhall	29.3

Per capita consumption can also be expected to be higher in large centres due not only to increased industrial and commercial use, but also to increased municipal use. This tendency shows up in Alberta when municipalities are grouped to test for differences between villages/hamlets and cities/towns, both with and without the effects of industry. The results of the test without the effects of industry are presented in the following table (5-18).

TABLE 5-18

AVERAGE PER CAPITA CONSUMPTION PER DAY IN ALBERTA IN 1972, WITHOUT THE EFFECTS OF INDUSTRY, BY STATUS OF COMMUNITY

	gpcd (*ℓpcd*)			
Status	0-50 *0-227*	51-75 *228-340*	76-100 *341-455*	100+ *456+*
Cities/Towns	9	21	10	14
Villages/Hamlets	18	16	5	5

Chi-square significant at .05

Increases in Demand

The demand for residential water is increasing in the majority of communities in Alberta, and declining in a relatively small proportion of them. Although these changes in demand may be noted from year to year, they are particularly evident over the five to six year period for which the data are available. General increases in total consumption may be expected in a growing province, in which many communities increase their population quite significantly from year to year (Table 5-19). More significant is the general trend of increases in average per capita consumption per year, which indicates that even in slowly growing communities, increasing demand can put pressure upon plant facilities and water supplies (Table 5-20).

TABLE 5-19

PERCENT OF ALBERTA COMMUNITIES SHOWING INCREASES OR DECREASES IN ANNUAL CONSUMPTION

Percentage Increases/ Decreases	Years					
	1966-1967	1967-1969	1969-1971	1971-1972	1966-1971	1966 1972
Decreases						
More than -20	0.9	14.5	5.6	1.2	13.4	13.3
-20 to -16	-	7.2	3.7	-	3.0	4.0
-15 to -11	3.7	1.4	5.6	4.8	4.5	1.3
-10 to -6	0.9	2.9	13.0	3.6	1.5	2.7
-5 to -2	0.9	4.3	5.6	8.4	3.0	1.3
-1 to +1	14.7	7.2	13.1	26.5	1.5	-
Increases						
2 to 5	14.7	2.9	7.4	6.0	7.5	1.3
6 to 10	23.9	13.0	13.0	19.3	1.5	2.7
11 to 15	12.8	10.1	11.1	9.6	3.0	2.7
16 to 20	11.9	2.9	9.3	8.4	6.0	4.0
21+	15.6	33.3	13.0	12.0	55.2	66.7
Total Number of Observations	109	69	54	83	67	75

TABLE 5-20

PERCENT OF ALBERTA COMMUNITIES SHOWING INCREASES OR DECREASES IN AVERAGE ANNUAL PER CAPITA CONSUMPTION

Percentage Increases/ Decreases	Years					
	1966-1967	1967-1969	1969 1971	1971-1972	1966-1971	1966 1972
Decreases						
More than -20	0.9	17.4	9.4	1.2	16.9	12.2
-20 to -16	0.9	4.3	5.7	2.4	3.1	4.1
-15 to -11	3.7	5.8	9.4	11.0	1.5	2.7
-10 to -6	2.8	5.8	13.2	4.9	3.1	5.4
-5 to -2	5.6	5.8	3.8	11.0	3.1	1.4
-1 to +1	13.1	5.8	13.3	15.9	6.1	4.1
Increases						
2 to 5	17.8	5.8	5.7	6.1	4.6	2.7
6 to 10	23.4	11.6	17.0	12.2	6.2	4.1
11 to 15	14.0	5.8	9.4	13.4	6.2	6.8
16 to 20	7.5	5.8	7.5	3.7	7.7	4.1
21+	10.3	26.1	9.4	18.3	41.5	52.7
Total Number of Observations	107	69	53	82	65	74

It would appear that the rate of per capita increases in demand is related to the population and municipal status of the community. Although the data must be grouped to meet the assumptions of the chi-square test, it seems that in the larger centres there is a greater tendency toward increases in per capita consumption. However, of the smaller communities in which per capita increases are evident, the increases tend to be significantly higher (Table 5-21). Although the results in Table 5-21 are only for the years 1966-1972, the pattern is similar in other cases involving 5 to 6 year time periods when tests are made with both population size and municipal status.

TABLE 5-21

POPULATION OF ALBERTA COMMUNITIES BY PER CAPITA INCREASES OR DECREASES IN CONSUMPTION, 1966 TO 1972

		Increases %	
Population	Decreases	1-20	21+
Up to 1000	13	1	24
1001+	8	12	15
	21	13	39

Chi-square significant at .05

Peak Demands

As noted in Chapter 3, peak demand characteristics are important in that they often dictate the capacity of plant facilities, and may result in unnecessary expenditures. Large portions of this peak demand usually go to "non-essential" uses such as lawn-watering, and are therefore subject to reduction through the application of management alternatives.

In Alberta, peak monthly consumption is a significant factor in demand patterns. Of the 98 communities for which data are available, average monthly consumption was exceeded by more than 50 percent in the peak month in 19.5 per cent of the municipalities, and 48.9 percent of the communities exceeded lowest month by more than 50 percent, and often by as much as three to four times (Table 5-22). If the lowest month is assumed to be one in which water consumption is restricted to mainly essential uses, there should be some room for reduction when 1½ to 4 times that amount ~~is~~ consumed. In the majority of communities (81.6 percent) peak demands also occur in the four months of May to August when the use of water for lawn irrigation, car washing, and swimming pools is at its peak (Table 5-23).

Peak day demand is perhaps even more significant than monthly demand in terms of setting design parameters for treatment, pumpage, and storage. The distribution of per capita consumption on peak days as a percentage of average per capita consumption closely parallels that of peak monthly demands (Table 5-24). In 1972, 74.1 percent of the observed communities had peak per capita consumption per day exceed average per capita demands by more than 150 percent. In 1971, 71.7 percent of the observed communities suffered peak day demands which exceeded 150 percent of average annual demands, with two communities exceeding 600 percent of average demand in both years.

TABLE 5-22

PEAK MONTH CONSUMPTION IN ALBERTA COMMUNITIES AS A PERCENT OF AVERAGE AND LOWEST MONTHS OF CONSUMPTION, 1972

	Number and Percentage of Communities in Each Category			
	Peak Month Over Average Month		Peak Month Over Lowest Month	
Percent	Number	Percent	Number	Percent
100-110	22	22.4	17	17.3
111-125	31	31.6	5	5.1
126-150	26	26.5	28	28.6
151-175	8	8.2	16	16.3
176-200	8	8.2	10	10.2
201-300	3	3.1	11	11.2
301-400	1	-	11	11.2
	98	100.0	98	100.0

TABLE 5-23

NUMBER AND PERCENT OF ALBERTA COMMUNITIES HAVING MAXIMUM CONSUMPTION IN EACH MONTH, 1971, 1972.

	1971		1972	
Month	Number	Percent	Number	Percent
January	-	-	-	-
February	1	1.5	-	-
March	4	6.2	4	5.7
April	1	1.5	2	2.9
May	11	16.9	10	14.3
June	15	23.1	23	32.9
July	12	18.5	12	17.1
August	15	23.1	13	18.6
September	3	4.6	2	2.9
October	-	-	1	1.4
November	1	1.5	1	1.4
December	2	3.1	2	2.9
	65	100.0	70	100.0

As might be anticipated, the peak demands tend to be much higher in the drier portions of the province, namely in the South Saskatchewan river basin (Tables 5-25 and 5-26). A greater proportion of the communities in the South Saskatchewan basin tend to have higher peak to average demand ratios, as well as peak month to lowest month demand ratios. It may be these peaks which account for the greater

TABLE 5-24

PEAK DAY PER CAPITA CONSUMPTION IN ALBERTA COMMUNITIES AS A PERCENT OF AVERAGE PER CAPITA CONSUMPTION

	Number and Percent of Communities in Each Category			
	1971		1972	
Percent	Number	Percent	Number	Percent
100-110	1	1.9	1	1.6
111-125	1	1.9	4	6.5
126-150	13	24.5	11	17.7
151-175	9	17.0	8	12.9
176-200	11	20.8	14	22.6
201-300	12	22.6	19	30.6
301-400	4	7.5	3	4.8
401-600	-	-	-	-
601+	2	3.8	2	3.2
	53	100.0	62	100.0

proportion of shortages suffered in southern Alberta, as was illustrated in Table 5-11.

TABLE 5-25

NUMBER OF COMMUNITIES IN EACH RIVER BASIN IN ALBERTA, CLASSIFIED ACCORDING TO PEAK MONTH CONSUMPTION AS A PERCENT OF AVERAGE MONTHLY CONSUMPTION, 1972

	Percentage		
River Basin	100-125	126-150	151+
South Saskatchewan	6	2	11
Red Deer	11	8	-
North Saskatchewan	24	11	6
Peace/Athabasca	12	5	2
	53	26	19

Chi-square significant at .05

TABLE 5-26

NUMBER OF COMMUNITIES IN EACH RIVER BASIN IN ALBERTA, CLASSIFIED ACCORDING TO PEAK MONTH CONSUMPTION AS A PERCENT OF LOWEST MONTH CONSUMPTION, 1972

	Percentage		
River Basin	100-125	126-150	151+
South Saskatchewan	5	1	13
Red Deer	3	9	7
North Saskatchewan	9	13	19
Peace/Athabasca	5	5	9
	22	28	48

Chi-square significant at .05

Regional Variations in Demand

Using average per capita consumption per day as an index of demand, we may infer that consumers in the South Saskatchewan river basin tend to demand greater quantities of water than do consumers in the more northerly parts of Alberta (Table 5-27). As in the case of peak demands which are also of greater magnitude in the South Saskatchewan basin, these differences probably stem from the drier climate and the greater use of water for lawn irrigation. These results, portayed in Table 5-27, also occur if per capita consumption without the effects of industry is considered.

TABLE 5-27

AVERAGE PER CAPITA CONSUMPTION PER DAY, 1972, BY RIVER BASINS IN ALBERTA

	gpcd (*ℓpcd*)		
River Basin	0-50 *0-227*	51-75 *228-340*	76+ *341+*
South Saskatchewan	1	2	16
Red Deer	8	8	3
North Saskatchewan	11	19	11
Peace/Athabasca	6	7	6
	26	36	36

Chi-square significant at .01

Demand Projections

Demand projections have been undertaken in only 27 percent, or 45 of the communities sampled. Of these projections, 71 percent were a straight-line projection from past demands, 12 percent were based on future growth projections at present per capita demands, and the remaining number of respondents were uncertain as to what their projections were based on.

Most of the inadequacies of demand projections referred to in Chapter 3 appear to be intrinsic to those completed in Alberta. None of the projections appear to account for changes in the rate of growth of per capita demand, nor do they allow for the possibility of changing demand patterns through pricing or rationing policies. These inadequacies seem particularly significant when it is considered that the majority of projections have been made in the larger centres (Table 5-28). Although 80 communities have undertaken expansions, and only 45 have undertaken projections, it is evident that most projections are completed in conjunction with system expansions.

TABLE 5-28
ALBERTA COMMUNITIES WHICH HAVE MADE DEMAND PROJECTIONS BY MUNICIPAL STATUS, 1973

Status	Projections	No Projections
Cities	8	1
Towns	34	38
Villages/Hamlets	2	74
	44	113

Chi-square significant at .001

METERING

Extent of Metering

Universal metering of water consumers is undertaken in the majority of Alberta municipalities. That is, 64 percent of all communities meter sales to industrial, commercial, and residential users (Table 5-29). Sixty-six percent of the respondents also meter their pumps. Unfortunately, there is no relationship between customer metering and the metering of pumps, which is significant to the calculation of losses due to leakage (Table 6-30).

TABLE 5-29

EXTENT TO WHICH METERING IS EMPLOYED IN ALBERTA COMMUNITIES, 1973

Metering	Number	Percent
Not Used	42	26.4
Commercial/Industrial Only*	15	9.4
Universal	102	64.2
	159	100.0

* Includes Calgary, which meters a portion of the residential customers.

The use of metering for residential purposes is dependent to some extent upon population size and municipal status, with greater proportions of the larger communities involved in residential metering (Table 5-31). Whether or not pumps are metered does not seem to be related to either population or municipal status.

TABLE 5-30

RELATIONSHIP BETWEEN EXTENT OF CUSTOMER METERING AND THE METERING OF PUMPS IN ALBERTA COMMUNITIES, 1973

	Pumps	
Customer Metering	Metered	Not Metered
Not Used	22	18
Commercial/Industrial Only*	10	4
Universal	68	28
	100	50

Chi-square not significant at .05

* Includes Calgary which meters a portion of the residential customers.

TABLE 5-31

POPULATION OF ALBERTA COMMUNITIES BY METERING OF RESIDENTIAL CUSTOMERS, 1973

	Residential Customers	
Population	Metered	Not Metered
0-500	30	34
501-1000	20	7
1001-2000	20	8
2001-5000	20	6
5001+	12	2
	102	57

Chi-square significant at .05

Impact of Metering

It was anticipated that metering might have an impact in at least three areas of residential water supply: the demand for water, the profitability of the water utility, and the amount paid for water.

The use of metering does appear to have an impact upon demand levels. There is a signficant difference in average per capita consumption per day between metered and unmetered residential communities. Those communities without metering tend to have a high level of per capita demand (Table 5-32). Metering, though, does not appear to have any consistent effect upon per capita increases in demand, nor upon the size of peak demands.

TABLE 5-32

IMPACT OF RESIDENTIAL METERING IN ALBERTA ON AVERAGE PER CAPITA CONSUMPTION PER DAY, WITHOUT THE EFFECTS OF INDUSTRY, 1972

	gpcd (*ℓpcd*)			
Residential Customers	0-50 *0-227*	51-75 *228-340*	76-100 *341-454*	101+ *455+*
Metered	23	29	11	7
Not Metered	4	7	3	10

Chi-square significant at .01

Residents of metered communities also tend to pay more for their water, in terms of average monthly water bills, than do residents of unmetered communities. This difference, however, cannot really be considered to be of any great consequence since most Albertans pay relatively low amounts for their water (Table 5-33).

TABLE 5-33

IMPACT OF RESIDENTIAL METERING IN ALBERTA ON AMOUNT OF AVERAGE MONTHLY WATER BILL, 1972

Residential Customers	Water Bill (Dollars) 0-5.00	5.01+
Metered	34	61
Not Metered	37	14

Chi-square significant at .001

Despite the fact that the communities with metering tend to have both lower per capita consumption, and higher revenues per service, their water supply utilities tend to have a greater propensity to suffer deficits (Table 5-34). This could be due to a problem of the price attached to the metering being too low, or possibly, meters were installed because the community was using too much water and losing money already. Or, in light of the fact that out of the 77 communities in which system expansions have taken place 57 communities are metered, it may be that the utilities are paying off capital expenditures. The above is only conjecture, however, and has not been documented.

TABLE 5-34

IMPACT OF RESIDENTIAL METERING ON PROFITS AND LOSSES OF WATER UTILITIES IN ALBERTA, 1972

Residential Customers	Profit	Broke Even	Loss
Metered	26	19	37
Not Metered	25	4	12

Chi-square significant at .05

PRICING

Types of Pricing Schedules

Four types of pricing schedules are used in Alberta, the predominant one being flat rate. A notable number of municipalities (25.8 percent) use a Declining Block Rate (DBR) schedule. Over four percent of the respondents reported using an Increasing Block Rate schedule (IBR), but not all of them included a copy of their pricing schedule to allow for verification (Table 5-35). Since the number of communities with IBR schedules is small they were grouped with those having constant rates, and for purposes of analysis are categorized as "con-servation" schedules.

The type of schedule used by a community is determined largely by its population size. This determination stems not only from the fact that smaller communities do not have metering and thereby use a flat rate, but that communities with metering, particularly those with a population of less than 1,000, have a much greater tendency to use a

TABLE 5-35

TYPES OF PRICING SCHEDULES USED IN ALBERTA, 1973

Schedule	Number	Percent
Flat Rate	63	41.7
Declining Block Rate	39	25.8
Increasing Block Rate	7	4.7
Constant Rate	42	27.8
	151	100.0

conservation rate than larger towns which tend to use a DBR schedule (Table 5-36). This tendency may be due to a preference on the part of smaller towns to use a simplistic pricing schedule which is easily applied, plus a desire on the part of larger communities to provide cheap water to large consumers in order to encourage industrial growth and economic development.

More difficult to explain is the tendency for communities in the South Saskatchewan River Basin to use flat rate pricing schedules. The South Saskatchewan has no significant tendencies towards smaller communities, and in such a water deficient area, the fact that 68 percent of the municipalities in that basin use flat rate schedules in difficult to rationalize (Table 5-37).

TABLE 5-36

POPULATION OF COMMUNITIES IN ALBERTA BY TYPE OF PRICING SCHEDULE, 1973

Population	Schedule		
	Flat Rate	D.B.R.	Conservation
0-500	39	2	22
501-1000	8	6	12
1001-2001	9	11	5
2001-5000	6	12	6
5001+	1	8	4

Chi-square significant at .001

TABLE 5-37

FREQUENCY OF USE OF DIFFERENT SCHEDULE TYPES BY RIVER BASINS IN ALBERTA, 1973

River Basin	Schedule Type		
	Flat Rate	D.B.R.	Conservation
South Saskatchewan	20	4	6
Red Deer	9	9	13
North Saskatchewan	23	15	24
Peace/Athabasca	11	11	6

Chi-square significant at .05

Structure of Schedules

The structures of the schedules used in Alberta are similar to those used elsewhere. The constant rate schedule, as used in Alberta, involves the use of a minimum charge for a minimum amount of water. The second block continues at a constant rate per unit of water.

The number of blocks in the IBR and DBR schedules is small for most communities. Of the 33 communities with DBR and IBR schedules for which a copy of the pricing schedule was included, 17 had only 3 blocks, and 16 had 4 or more, including the first minimum block. Thus, the opportunities for having the demand curve reflected in the schedule appear to be limited, while the opportunity of getting cheaper water through high consumption appears to be quite promising.

There is a definite tendency for smaller communities to use fewer blocks (Table 5-38). Since larger municipalities also tend to use DBR schedules, it would seem that the larger communities are committed to providing high volume consumers with inexpensive water.

In order to assess more completely the ability to consumers to control the amount of their water bills under existing schedules, consideration was directed towards the size of the first minimum block in the price schedules, and the size of the units for which the consumer is charged in the second block.

The majority of communities have their first

TABLE 5-38

STATUS OF ALBERTA MUNICIPALITIES BY NUMBER OF BLOCKS IN WATER PRICING SCHEDULE, 1973

Status	Number of Blocks 1-2	 3	 4+
City	3	1	5
Town	14	14	7
Village/Hamlet	22	2	4

Chi-square significant at .01

block in the range of 1001-4000 gallons (4550 - 18 184 l) as a minimum per month (Table 5-39). If average consumption per capita were assumed to be 50 gpcd (227 lpcd), a low estimate of monthly household consumption, (assuming 3.5 persons per household), would be in the order of 5,250 gallons (23 866 l). In the majority of towns, then, the average household will probably exceed the minimum amount, which means that opportunities for savings will depend upon the size of units in the second block. This possibility is limited, however, in that 61 percent of the responding communities had their second block units in thousands of gallons, and an additional 15 percent used units of 601-700 gallons (2632-3182 l). Only 18 percent of the communities had the second block in 100 gallon (454 l) units (Table 5-40).

Moreover, in the 72 communities under considera-

TABLE 5-39

SIZES OF FIRST BLOCK IN WATER PRICING SCHEDULES USED IN ALBERTA COMMUNITIES, 1973

Size in		Schedules	
Gallons	(m^3)	Number	Percent
0-100	*(0-.45)*	3	4.3
1001-2000	*(.46-.90)*	19	27.1
2001-3000	*(.91-1.4)*	24	34.3
3001-4000	*(1.5-1.8)*	11	15.7
4001-5000	*(1.9-2.3)*	5	7.1
5001-6000	*(2.4-2.7)*	3	4.3
6001+	*(2.8+)*	5	7.1
		70	100.0

TABLE 5-40

SIZES OF UNITS IN THE SECOND BLOCK OF WATER PRICING SCHEDULES USED IN ALBERTA COMMUNITIES, 1973

Size in		Schedules	
Gallons	*(Litres)*	Number	Percent
0-100	*0-454*	13	18.1
101-200	*455-090*	-	-
201-300	*910-1363*	1	1.4
301-400	*1364-1818*	-	-
401-500	*1819-2273*	2	2.8
501-600	*2274-2727*	-	-
601-700	*2728-3182*	11	15.3
701-800	*3183-3637*	-	-
801-900	*3638-4091*	-	-
901-1000	*4092-4546*	44	61.1
1001+	*4547+*	1	1.4
		72	100.0

tion here, the first large block holds no incentives for saving water in that 69 percent of them have a minimum charge of between 2 and 5 dollars. Only 25 percent had a minimum charge exceeding 5 dollars. Most communities also have a relatively uniform charge in terms of average cost per gallon in the second block. For units up to 100 gallons (454 l), the average charge per unit was 10 cents; for 200-300 gallons (909 - 1363 l), 25 cents and so on (Table 5-41).

TABLE 5-41

AVERAGE COSTS OF VARIOUS SIZED UNITS IN SECOND BLOCK OF WATER PRICING SCHEDULES USED IN ALBERTA COMMUNITIES, 1973

Size of Unit		Number of	Average Cost
Gallons	*Litres*	Observations	(Dollars)
0-100	*0-454*	13	0.10
101-300	*455-1363*	1	0.25
301-500	*1364-2273*	2	0.375
501-700	*2274-3182*	11	0.505
701-100	*3183-4546*	44	1.25
1001-2000	*4547-9092*	1	5.00

Price

The weighted mean monthly water bill paid by the average Alberta household in 1973 was 4.66 dollars. This figure is distorted somewhat by the fact that some communities include sewer charges with the waterbill, and some do not. Thus, the distribution of average monthly waterbills will vary according to billing methods (Table 5-42). The weighted mean household water bill for all communities which include sewer charges in the bill is about 6.65 dollars per month. In those municipalities which charge separately for sewage services, the weighted mean waterbill is 4.25 dollars per month.

TABLE 5-42

PERCENTAGE DISTRIBUTION OF AVERAGE AMOUNTS OF WATERBILLS IN ALBERTA COMMUNITIES WITH DIFFERENT MEANS OF CHARGING FOR SEWERAGE SERVICES, 1973

	Amount (Dollars)			
Means of Charging	0-5.00	5.01-10.00	10.01+	Total
Sewer charges included	28.8	62.1	9.1	66
Sewer charges sent with bill	68.3	29.3	2.4	41
Sewer charges not included, not sent with bill	60.4	37.5	2.1	48
Overall distribution	49.0	45.8	5.2	155

Prices have remained reasonably stable in Alberta, and only 44 (or 27 percent) of the sampled communities have had recent price changes of which only one was a decrease. Of those communities which have adjusted their prices upward, 80 percent did so to meet increased capital requirements.

Impact of Different Schedule and Pricing Policies

The type of schedule used appears to be related to average per capita consumption, peak to low month ratios, amount of waterbills, and whether or not the water utility enjoys a profit or suffers a loss. Although it is difficult to document, it should be noted that some of these relationships may stem from the accumulative effects of price, metering, community population, source, and regional variations in demand.

The type of schedule used has a definite impact upon the average waterbill paid by consumers. It was previously shown that the use of metering is related to average waterbills, but it also appears that the highest waterbills can be traced to those municipalities with DBR schedules. A greater proportion of the utilities in communities with a conservation schedule tend to charge less (as in those with a flat rate), than in those communities where a DBR schedule is utilized (Table 5-43). However, a greater proportion of utilities operating with a conservation rate tend to suffer a loss than either those with DBR or flat rate schedules (Table 5-44). This problem might be attributed to the fact that conservation schedules are more frequent in smaller communities, and the revenue per service is lower than for communities with DBR. Thus, these communities are attempting to operate a metered system, and are possibly paying off capital expenditures, on lower revenues than communities with DBR schedules.

TABLE 5-43

PRICING SCHEDULE TYPE BY AVERAGE MONTHLY WATER BILL IN ALBERTA COMMUNITIES, 1973

	Amount (Dollars)	
Schedule Type	0-5.00	5.01+
Flat Rate	40	19
Declining Block Rate	9	27
Conservation Rate	23	18

Chi-square significant at .001

TABLE 5-44

FREQUENCY OF PRICING SCHEDULE TYPE IN ALBERTA COMMUNITIES BY WHETHER OR NOT THE UTILITY SHOWS A PROFIT OR LOSS, 1972

	Schedule		
	Flat Rate	DBR	Conservation
Profit	28	13	11
Broke Even	4	6	11
Loss	16	11	11

Chi-square significant at .05

Schedule type does have a significant impact upon per capita consumption, and one which cannot be attributed to any other immediate relationships. The greatest proportion of communities with flat rate schedules are in higher consumption categories. The greatest proportion of communities which have instituted conservation rates tend to be in the lowest category, while the consumption rates in communities with DBR schedules fall mainly in the middle categories of consumption. This is borne out when both per capita consumption (Table 5-45) and average per capita consumption without the effects of industry (Table 5-46) are considered.

TABLE 5-45

PRICING SCHEDULE TYPE BY AVERAGE PER CAPITA CONSUMPTION PER DAY IN ALBERTA COMMUNITIES, 1972

	gpcd (*ℓpcd*)			
Schedule Type	0-50 *0-227*	51-75 *228-340*	76-100 *341-454*	101+ *455+*
Flat Rate	8	5	4	10
Declining Block Rate	7	16	6	2
Conservation Rate	12	9	5	4

Chi-square significant at .05

It also appears that schedule type is associated with peak month to lowest month ratios, with the conservation schedule category having the highest ratios (Table 5-47). This relationship is inconsistent with the fact that municipalities with conservation schedules have lower average per capita consumption. However, it may be that in those

TABLE 5-46

PRICING SCHEDULE TYPE BY AVERAGE PER CAPITA CONSUMPTION PER DAY IN ALBERTA COMMUNITIES, WITHOUT THE EFFECTS OF INDUSTRY, 1972

Schedule Type	gpcd (*ℓpcd*) 0-50 *0-227*	 51-75 *228-340*	 76-100 *341-454*	 101+ *455+*
Flat Rate	5	8	4	10
Declining Block Rate	8	17	5	1
Conservation Rate	12	9	5	4

Chi-square significant at .05

communities with conservation rates, the consumption levels in off-peak months are generally lower than in communities with other types of schedules. If this is the case, it illustrates well the need for either summer differential rates, or IBR schedules.

TABLE 5-47

PRICING SCHEDULE TYPE BY PEAK MONTH CONSUMPTION AS A PERCENT OF LOWEST MONTH CONSUMPTION IN ALBERTA COMMUNITIES, 1972

Schedule Type	Percentage 100-125	 126-150	 151-200	 201+
Flat Rate	9	6	4	8
Declining Block Rate	8	11	9	3
Conservation Rate	2	9	12	7

Chi-square significant at .05

No effects on demand due to price charged are evident. This is to be expected, considering the small range of prices charged, and the fact that very few communities have tried to influence demand through pricing. Demand does seem to be influenced by metering and schedule type, which suggests that perhaps price may be a tool which is still open to successful exploitation.

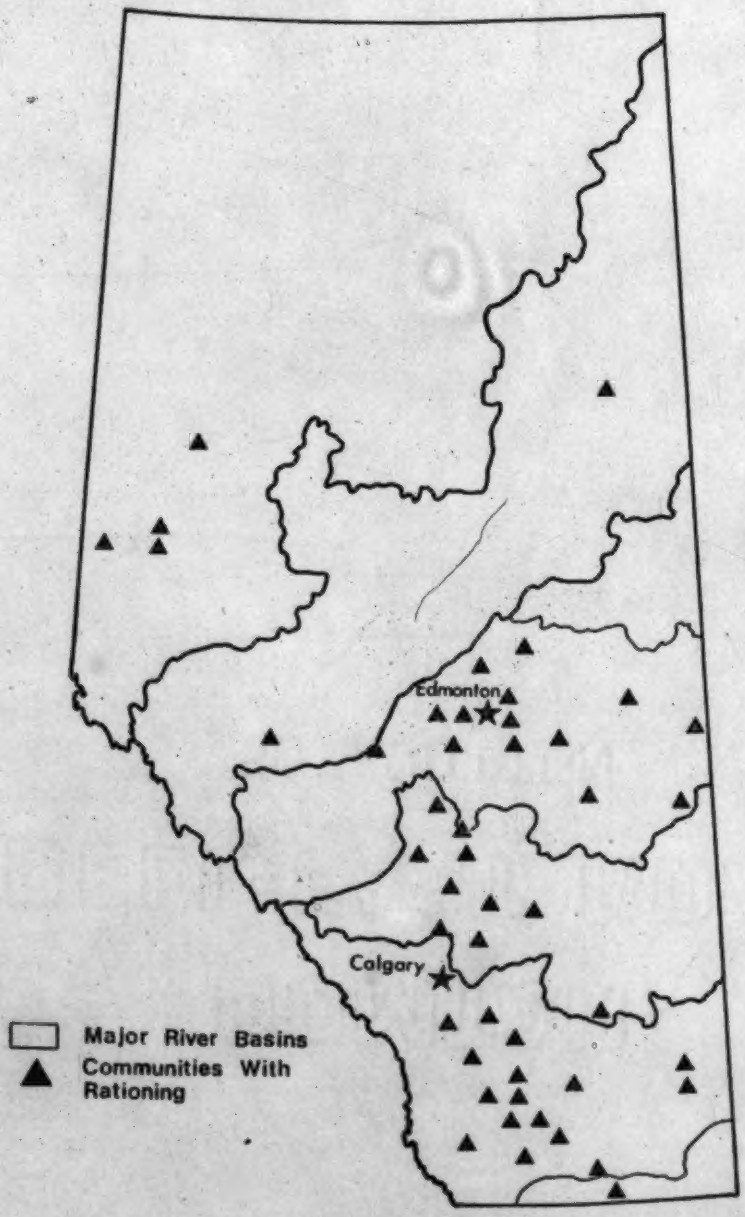
RATIONING

Extent of Use

Since January, 1969, rationing has been implemented in 49 communities (or 30 percent of those represented in the sample). A list of those communities is included in Appendix C, and their distribution is portrayed on Map 5-2.

There is evidence that rationing may be associated with growth, in that a greater proportion of large municipalities have had to implement rationing (Table 5-48). In some communities, the need to ration has been resolved, such as in those which are now hooked into Edmonton's regional system. However, 55 percent of the 70 communities which rationed from 1963 to 1968 were still rationing in the 1969 to 1973 sample.

The need to ration does not appear to be related to increases in either per capita or overall demand. Nor does rationing appear to be tied to peak month consumption patterns. However, the need to ration does appear to be associated with peak day demands, as they peaks are related


Edmonton
Calgary
Major River Basins
Communities With Rationing

Map 5-2 Spatial Distribution of Communities Reporting Rationing, Alberta, 1968 – 1972

TABLE 5 - 48

FREQUENCY OF MUNICIPAL STATUS BY RATIONING IN ALBERTA COMMUNITIES

	Rationing	
Status	Yes	No
Cities	5	4
Towns	25	49
Villages/Hamlets	19	64

Chi-square significant at .05

to maximum capacity of the system (Table 5-49). Thus, it would seem that rationing could possibly be avoided by controlling peak demands for limited periods of time.

TABLE 5-49

FREQUENCY OF RATIONING BY PERCENT OF MAXIMUM CAPACITY USED ON PEAK DAYS IN ALBERTA COMMUNITIES, 1972

	Percent of Maximum Capacity Used		
Rationing Used	0-75	76-90	91-100
Yes	4	3	10
No	20	14	8

Chi-square significant at .05

A high proportion of communities which have rationed are located in the South Saskatchewan basin (Table 5-50). This tendency is probably related to the greater magnitude of peak demands which occur in the southern parts of the province.

TABLE 5-50

NUMBER OF ALBERTA COMMUNITIES IN EACH RIVER BASIN WHICH HAVE RATIONED WATER

River Basin	Have Rationed	Have Not Rationed
South Saskatchewan	19	17
Red Deer	8	25
North Saskatchewan	15	51
Peace/Athabasca	7	24

Chi-square significant at .01

The possible effects of peak demands on the need to implement rationing are suggested to some extent by the temporal nature of rationing. Ninety-one percent of the rationing was implemented in summer, seven percent in winter, and in only two percent of the communities was it a year round problem. Although no concrete data was collected on the number of times each community had to ration, it is a recurrent problem with the majority of the communities in which this type of demand control has been instituted.

Implementation

Of the municipalities which undertook rationing, 55 percent used the common approach of instituting alternate days for lawnwatering, 17 percent controlled lawnwatering hours during the day, 15 percent left reduced consumption entirely up to voluntary restraints on the part of the consumer, and the remainder used other means such as only turning the water on for certain hours each day, police enforcement of bylaws, and reduction of water pressure.

Eighty percent of the rationing municipalities also undertook ~~to~~ control water use through exhortation, in which case people are asked to voluntarily reduce their consumption. Of these 39 communities, almost half undertook a door to door campaign asking people not to use too much water, a like proportion advertised through radio and/or newspapers, and a few others tried such means as a note with the waterbill. Generally, exhortation was reported to be a reasonably successful means of reducing water consumption during critical periods.

SUMMARY

The two areas of discussion in this chapter were the documentation of the present use and the potential for use of management alternatives. Supplementary to the above is the presentation of the data on which the following behavioural analysis is based.

It has been illustrated that many of the demand characteristics, and the use of management alternatives, are determined to some extent by physical factors such as population size, and regional differences in climate and water availability. These factors, however, cannot be considered to have exclusive influence over either demand characteristics or the selection of management alternatives. For example, demand characteristics are affected by decisions to meter, and not all communities which suffer shortages implement rationing. The reasons for this may be in the behavioural sphere.

Secondly, the data in this chapter illustrate the need for the application of management alternatives in Alberta. As may be noted in the tabular summary of the analysis which has been undertaken up to this point, relationships are already evident among schedule type, consumption levels, peak demands, and average waterbills. Relationships are also evident among the presence of metering, consumption levels, and average waterbills (Table 5-51). The results, then, show both the need for and the potential for the evaluation of management alternatives in a more sophisticated manner than at present. Water source and quality aspects for example, are not generally the basis for severe problems. Rather, shortages tend to occur in systems in which high peak to average demand ratios are evident, with only a small proportion of centres actually suffering a water shortage. In some instances, even this problem might be relieved through reduction of peak demands.

TABLE 5-51

TABULAR SUMMARY OF AREAS OF SIGNIFICANCE IN ANALYSIS OF SUPPLY AND DEMAND CHARACTERISTICS IN ALBERTA COMMUNITIES

	Quality	Shortages	Municipal Status	Population	Schedule Type	Profit/Loss	Metering	Rationing	River Basin
Source	X			X					X
Shortages									X
Population					X	X			
Schedule Type						X			X
Metering			X	X		X			
Demand Projections			X	X					
Average per capita consumption/day			X		X				X
Average/capita/day no industry			X		X		X		X
Per Capita Increases/ Decreases			X	X					
Peak Month/Average Month									X
Peak Month/Low Month					X				X
Rationing		X	X						X
River Basin	X								
Water/Sewer			X						
Past Expansions			X	X	X		X		
Water Bill					X		X		
Number of Blocks in Water Bill			X						
% of maximum capacity								X	
Future expansions			X	X					

Finally, it is evident in the data patterns that management alternatives are only rarely used in a deliberate manner to affect the demands of water.

Thirdly, the data presented above lend support to the premise that demand characteristics in Alberta are similar to those of other areas of North America. Thus, the nomothetic value of the study is confirmed to a certain extent, and it may be assumed that some of the generalizations in this study might be applied to water supply and demand situations elsewhere. This is particularly important to the following behavioural analysis, for the decision setting is probably much the same in Alberta as elsewhere in Canada or the United States.

Finally, a review of the above inventory reveals some areas in which information gaps exist, in terms of the information required by water managers to effectively implement management alternatives and to use water efficiently for residential purposes. For example, many water managers lack documentation of consumption and peak demand patterns, of quantities of water consumed, and even of the capacity of their water distribution systems. More detailed and extensive information is also required on leakage problems, for the amount of water lost and the possible savings in this area are largely ignored. Demand projections also tend to be inadequate and too simplistic, although it must be acknowledged that it is difficult to account for pricing policies which do not exist, and demand characteristics which are unknown.

In this chapter, the "physical" inventory of residential water supply and demand has been completed. The following chapter will be devoted largely to a similarly descriptive analysis of perceptions of and attitudes towards the use of management alternatives in Alberta. It is in Chapter 7 that this chapter and chapter 6 will be brought together, and in which the relationships between physical characteristics and behavioural tendencies will be indicated.

CHAPTER 6

PERCEPTIONS, ATTITUDES, AND MANAGEMENT ALTERNATIVES

Two major objectives in the research project are approached in this chapter. These objectives, as outlined in Chapter 4, are:

(a) To determine the perceptions and attitudes of water managers in Alberta as these perceptions and attitudes relate to the use of management alternatives, to their role as water managers, and to their general attitudes toward water supply and water conservation in a residential setting.

(b) To determine whether managerial perceptions coincide with the generalities expressed in the literature and thereby corroborate the nomothetic nature of the study.

In consideration of the above objectives, the format of the data presentation in this chapter will be as follows: firstly, the general attitudes of water managers toward residential water supply will be described and discussed; secondly, the perceptions and attitudes related to water conservation will be documented; thirdly, the relationships among perceptions, attitudes, and the use of management alternatives will be explored; and finally, brief consideration will be given to determining what water managers feel the public expects from them, and what they perceive their role to be.

GENERAL ATTITUDES TOWARD WATER SUPPLY

It is apparent from the literature reviewed in Chapters 2 and 3 that the provision of residential water is of prime importance to most communities in North America, and Alberta offers few exceptions. Forty-nine percent, or 81 of the respondents, indicated that residential water supply, when competing for funding with other municipal projects, took highest priority. Very few managers gave water a low priority, and those who did either represented municipalities which purchased water or had a system which was financially independent (Table 6-1).

An attempt was made to determine whether or not water managers feel it is right to restrict a person's consumption of water through the use of management alternatives. Only 40 percent of the respondents agreed that it is right to restrict consumption, and many of them added the qualification that it was right to do so only when necessitated by temporary water shortages (Table 6-2). The restriction of demand for water is seen by some managers as a basic moral question, for they feel that water is an essential good, and one to which people have a right.

8

TABLE 6-1

PRIORITY GIVEN TO THE PROVISION OF RESIDENTIAL WATER IN ALBERTA COMMUNITIES (WHEN COMPETING FOR FUNDS WITH SUCH THINGS AS ROADS, PARKS, AND RECREATIONAL FACILITIES)

	Number	Percent
Highest Priority	81	49.4
Fairly High Priority	70	42.7
Low Priority	5	3.0
Very Low Priority	2	1.2
Equal Priority With	5	3.0
Other	1	0.6
	164	100.0

CHAPTER 6-2

DISTRIBUTION OF RESPONSES TO THE QUESTION: "WOULD YOU AGREE OR DISAGREE THAT IT IS RIGHT TO RESTRICT A PERSON'S CONSUMPTION OF WATER?"

	Number	Percent
Strongly Agree	5	3.1
Agree	64	40.0
Undecided	35	21.9
Disagree	46	28.7
Strongly Disagree	10	6.2
	160	100.0

PERCEPTIONS, ATTITUDES, AND WATER CONSERVATION

Four statements in the Likert tables were directed at eliciting perceptions and attitudes related to water conservation. Two of these statements were related to the perceived need for and desirability of conserving water in the municipal system. To the question of whether or not individual water departments should conserve water, the general reaction was negative, although a large portion of the respondents remained neutral (Table 6-3). On the other hand, the majority of respondents agreed that water should be conserved in Alberta (Table 6-4). This may be a good example of the degree of commitment, in that many of the respondents were favourable to water conservation so long as it did not specifically apply to their own water supply utilities.

TABLE 6-3

DISTRIBUTION OF RESPONSES TO THE STATEMENT:
"USING AS LITTLE WATER AS POSSIBLE IS A WORTHWHILE
GOAL FOR ANY WATER DEPARTMENT"

	Number	Percent
Strongly Agree	6	3.7
Agree	42	25.6
Neutral	37	22.6
Disagree	75	45.7
Strongly Disagree	4	2.4
	164	100.0

It is noteworthy that the perception of whether or not water needs to be conserved in Alberta is related to

TABLE 6-4

DISTRIBUTION OF RESPONSES TO THE STATEMENT: "THERE IS NO NEED TO CONSERVE WATER, AT LEAST IN ALBERTA, BECAUSE THERE IS PLENTY OF WATER FOR EVERYBODY"

	Number	Percent
Strongly Agree	7	4.3
Agree	40	24.5
Neutral	28	17.2
Disagree	75	46.0
Strongly Disagree	13	8.0
	163	100.0

attitudes towards whether or not it is right to restrict consumption (Table 6-5). Many water managers equate conservation with restrictions on demand, and therefore, disagree that there is a need to conserve water in Alberta.

TABLE 6-5

CROSS TABULATION OF RESPONSES TO THE QUESTION: "IS IT RIGHT TO RESTRICT CONSUMPTION?" BY RESPONSES TO THE STATEMENT "THERE IS NO NEED TO CONSERVE WATER, AT LEAST IN ALBERTA"

Is it right to restrict consumption?	No need to conserve water		
	Agree	Neutral	Disagree
Agree	14	6	48
Neutral	5	12	18
Disagree	27	8	20

Chi-square significant at .05

The second pair of statements related to water conservation were based on the hypothesis that water managers opposed to demand restrictions and conservation would probably, to minimize cognitive dissonance, also underrate the utility of conservation measures. Although the above hypothesis is not borne out conclusively by statistical analysis, many of the respondents did reject the possibility that benefits might be derived from reduced consumption through savings on water supply and sewage treatment costs (Table 6-6).

TABLE 6-6

FREQUENCY OF RESPONSES TO STATEMENTS RELATED TO THE PERCEIVED BENEFITS OF RESIDENTIAL WATER CONSERVATION

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
If you could reduce the consumption of water per household, you could reduce the costs of supplying the water.	4	79	15	63	2
If you could reduce the consumption of water, you could reduce sewage treatment costs signi-ficiantly	3	56	37	59	2

PERCEPTIONS, ATTITUDES, AND THE USE OF MANAGEMENT ALTERNATIVES

Metering

Inasmuch as metering is fairly straightforward and commonly used, emphasis in this section is placed only upon its perceived effectiveness in reducing consumption. The initial impact of metering is well recognized, with 87 percent of the water managers indicating that they consider metering effective in reducing demand immediately after installation (Table 6-7). Many of the respondents, however, accept the argument that demand will return to normal after the meters have been installed for a year or two (Table 6-8).

TABLE 6-7

DISTRIBUTION OF RESPONSES TO THE QUESTION: "HOW EFFECTIVE DO YOU FEEL METERS WOULD BE IN REDUCING CONSUMPTION, PARTICULARLY AFTER THEY HAVE JUST BEEN INSTALLED?"

	Number	Percent
Very Effective	56	33.9
Effective	88	53.3
Undecided	7	4.2
Ineffective	11	6.7
Very Ineffective	3	1.8
	165	100.0

Pricing

Pricing was examined from two viewpoints: the manner in which price control was perceived as an effective tool in reducing demand, and the acceptability of price manipulation as a management alternative.

TABLE 6-8

DISTRIBUTION OF RESPONSES TO THE QUESTION: "IF THE CONSUMPTION OF WATER PER HOUSEHOLD WAS REDUCED BY METERING INITIALLY, DO YOU FEEL IT WOULD RETURN TO NORMAL AFTER THE METERS HAD BEEN INSTALLED A YEAR OR TWO?"

	Number	Percent
Yes	78	47.9
No	56	34.4
Undecided	29	17.8
	163	100.0

Generally speaking, water managers in Alberta are typical of those examined in previous studies. Most water managers feel that the best "rule of thumb" on which to base the price of water is to charge enough to cover system maintenance and delivery costs and build up some capital for future expansions. Less than 7 percent of the respondents felt it desirable to charge enough to discourage people from using too much water (Table 6-9).

In view of the above, it is not surprising that responses to the question of why particular pricing schedules were used fell into two categories: (1) price was set according to capital costs, and (2) it was considered to be the fairest (Table 6-10). Only 26 percent of the respondents felt that their pricing schedule could be improved upon, among them a number of managers who had argued for the installation of meters and increased prices, but whose

TABLE 6-9

DISTRIBUTION OF RESPONSES TO THE QUESTION: "WHAT WOULD YOU SAY IS THE BEST 'RULE OF THUMB' ON WHICH TO BASE THE PRICE OF WATER?"

Charge enough to	Number	Percent
cover the costs of delivery and system maintenance only	23	14
cover the costs of delivery and system maintenance, plus build up some capital for future expansion	97	59.1
cover the above, plus make a small profit	33	2[illegible].1
cover all of the above, as well as discourage people from using too much water	11	6.7
	165	100.0

recommendations were rejected by town council as politically unpopular.

Prices have been raised in only 9 percent of the communities for the express purpose of reducing consumption. However, 59 percent of the responding water managers felt that if metering was already available, raising the price of water would be effective in reducing demand levels (Table 6-11). As in the case of metering though 49 percent of the respondents (81) felt that demand would return to normal, 34 percent felt it would stay down, and 17 percent were undecided. Thus, it would seem that the value of both pricing and metering is not recognized by the majority of

TABLE 6-10

EXPLANATIONS FOR THE USE OF PARTICULAR PRICING SCHEDULES IN ALBERTA

Reason for use	Number	Percent
Bylaw, set by council	10	15.2
Size of community doesn't warrant meters	8	12.1
Considered to be fairest	19	28.8
Provides sufficient revenue to cover costs	21	31.8
To entice industry	2	3.0
To control the waste of water	6	9.1
	90	100.0

water managers. A reasonably large proportion do accept these alternatives as effective, though, and a fairly large number are undecided. It is possible that the latter group would be amenable to accepting these alternatives as valuable if they were presented with plausible information to that effect.

The reluctance of water managers to support price increases does not appear to stem from either a fear of the consequences of increasing the price or a feeling that people can not afford to pay higher waterbills. Rather, 56 percent of the managers feel that their community, through increased water rates, would be able to pay for an

TABLE 6-11

DISTRIBUTION OF RESPONSES TO THE QUESTION: "IF A COMMUNITY ALREADY HAD METERING, HOW EFFECTIVE DO YOU FEEL RAISING THE PRICE OF THE WATER WOULD BE IN REDUCING DEMAND?"

	Number	Percent
Very Effective	15	9.2
Effective	81	49.7
Undecided	27	16.6
Ineffective	38	23.3
Very Ineffective	2	1.2

expanded water supply system (Table 6-12), and it will be remembered that 27 percent of the communities have recently raised their prices. Of course, it is much easier to increase prices with the offer of a larger water supply system than it is to increase prices when the aim is to reduce consumption.

TABLE 6-12

DISTRIBUTION OF RESPONSES TO THE QUESTION: "HOW WOULD YOU JUDGE THE ABILITY OF YOUR COMMUNITY TO PAY, THROUGH HIGHER WATER RATES, FOR AN EXPANDED WATER SUPPLY SYSTEM?"

	Number	Percent
Very able	17	11.0
Able	70	45.2
Undecided	34	21.9
Not very able	28	18.1
Not at all able	6	3.9
	155	100.0

Overall, the water managers appear to have accepted the fact that pricing is effective in reducing consumption. However, although the alternatives of pricing and metering may be perceived as effective, they are not necessarily considered acceptable alternatives to that of meeting demand increases through increased supply. When examined on the abstract nature of the increasing block rate schedule, for example, most of the managers appeared to agree with the basic philosophy of charging more to high demand consumers. Nevertheless, although they tended to agree with the philosophy of IBR, they tended to reject the practical effects such pricing policies would have.

Thus, the majority of managers agreed with the statement on the Likert table that people who use more than a minimum quantity of water to cover basic needs should pay more for each unit above that minimum (Table 6-13). Similarly, the majority of respondents agreed that most people would be quite willing to pay more for extra units of water if they had to (Table 6-14). However, as is evident in Table 6-15, managers who feel that people are able to pay have a tendency to feel that people would be willing to pay. Consequently, agreement with these two statements may have been based more on the managers' perception of their communities' ability to pay more for water than acceptance of the philosophy of IBR pricing (Table 6-15).

TABLE 6-13

DISTRIBUTION OF RESPONSES TO THE STATEMENT: "EVERYONE SHOULD BE ALLOWED A CERTAIN MINIMUM QUANTITY OF WATER TO COVER BASIC NEEDS AND PEOPLE WHO USE MORE THAN THAT SHOULD PAY MORE FOR EACH UNIT OF WATER ABOVE THAT MINIMUM"

	Number	Percent
Strongly agree	34	20.9
Agree	81	49.7
Neutral	26	16.0
Disagree	19	11.7
Strongly disagree	3	1.8
	163	100.0

TABLE 6-14

DISTRIBUTION OF RESPONSES TO THE STATEMENT: "MOST PEOPLE WOULD BE QUITE WILLING TO PAY MORE FOR EXTRA UNITS OF WATER IF THEY HAD TO"

	Number	Percent
Strongly agree	8	4.8
Agree	90	54.5
Neutral	17	10.3
Disagree	48	29.1
Strongly disagree	2	1.2
	165	100.0

TABLE 6-15

CROSS TABULATION OF MANAGERS' PERCEPTIONS OF PEOPLE'S WILLINGNESS TO PAY BY PERCEPTIONS OF THEIR ABILITY TO PAY

People are willing to pay more	People are able to pay more able	undecided	unable
Agree	60	13	17
Neutral	7	7	2
Disagree	19	14	15

Chi-square significant at .01

The above tendency to equate increased rates with ability to pay may explain the reluctance to agree with the statements pertaining to the practical application of IBR pricing, and the implications of that schedule. On the three statements which suggested that people should have to pay more for water used to either irrigate their lawns, wash their cars, or fill their swimming pools, the tendency to disagree was quite significant (Table 6-16). It might be deduced from the above that not only would the implementation of IBR schedules likely be resisted, but so would such approaches to conservation as summer differential rates and demand metering.

It is evident that much of the resistance to the use of conservation schedules stems from the basic attitude that it is not right to restrict the demand for water. This polarization of attitudes has divided the respondents into

TABLE 6-16

PERCEPTION OF THE IMPLICATIONS OF CONSERVATION PRICING SCHEDULES

People should pay more for water used to:	Percentage Distribution				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Irrigate their lawns	5.5	17.7	19.5	51.8	5.5
Wash their car(s)	0.6	8.5	25.5	61.2	4.2
Fill their swimming pool	5.5	33.1	20.2	37.4	3.7

two groups, and between group differences occur on three of the above five statements. Those three statements were, (1) everyone should pay more per unit beyond a certain minimum quantity of water (Table 6-17); (2) people should have to pay more for water which they use to wash their cars (Table 6-18); and (3) people should have to pay more for water which they use to fill their swimming pools (Table 6-19). Notable here is the fact that a between group difference does not occur on the statement that people should pay more for water used to irrigate their lawns. Water for lawn irrigation is evidently seen as an essential good by both groups.

Rationing

Although rationing is bound to be effective to some extent, it is only rated as such by 53 percent of the

TABLE 6-17

PERCEPTION BY ALBERTA WATER MANAGERS OF WHETHER OR NOT IT IS RIGHT TO RESTRICT THE CONSUMPTION OF RESIDENTIAL WATER BY THEIR PERCEPTION OF WHETHER OR NOT PEOPLE WHO USE MORE THAN A BASIC MINIMUM QUANTITY OF WATER SHOULD PAY MORE

Right to restrict consumption?	People should pay more		
	Agree	Neutral	Disagree
Agree	52	7	9
Neutral	22	12	0
Disagree	38	6	12

Chi-square significant at .05

TABLE 6-18

PERCEPTION BY ALBERTA WATER MANAGERS OF WHETHER OR NOT IT IS RIGHT TO RESTRICT CONSUMPTION BY WHETHER OR NOT PEOPLE SHOULD PAY MORE FOR WATER USED TO WASH THEIR CAR(S).

Right to restrict consumption?	People should pay more		
	Agree	Neutral	Disagree
Agree	31	14	22
Neutral	13	10	11
Disagree	13	9	34

Chi-square significant at .05

TABLE 6-19

PERCEPTION BY ALBERTA WATER MANAGERS OF WHETHER OR NOT IT IS RIGHT TO RESTRICT CONSUMPTION BY WHETHER OR NOT PEOPLE SHOULD PAY MORE FOR WATER USED TO FILL THEIR SWIMMING POOLS.

Right to restrict consumption?	People should pay more		
	Agree	Neutral	Disagree
Agree	31	14	22
Neutral	13	10	11
Disagree	13	9	34

Chi-square significant at .05

respondents (Table 6-20). This discrepancy may be due to a lack of understanding of what rationing implies, or possibly an unwillingness to accept its utility due to problems of cognitive dissonance.

TABLE 6-20

DISTRIBUTION OF RESPONSES TO THE QUESTION: "HOW EFFECTIVE WOULD YOU CONSIDER RATIONING TO BE AS A MEANS OF REDUCING CONSUMPTION?"

	Number	Percent
Very effective	13	7.9
Effective	75	45.5
Neutral	36	21.8
Ineffective	35	21.2
Very ineffective	6	3.6
	165	100.0

The perception of rationing as an acceptable means of reducing consumption is dependent upon whether it is to be implemented for a short or long term. Over 56 percent of the managers feel rationing would be acceptable over a short period of time, but only 8 percent for long periods of time (Table 6-21). Thus, many water managers are reluctant to implement rationing at all, and are particularly reluctant to use it for anything more than short term crises.

TABLE 6-21

PERCEPTION OF RATIONING AS AN ACCEPTABLE MEANS OF REDUCING CONSUMPTION

Duration of implementation	Is It Acceptable % Yes	 % Maybe Yes	 % No	 % Undecided
Short Term	56.4	26.4	12.9	4.3
Long Term	8.2	18.9	68.6	4.4

The above perceptions of rationing are corroborated by the responses to several related statements in the Likert tables. These statements were intended to test for perceptions and attitudes which had implications for the willingness to ration. Two statements were directed at determining how the managers perceived the efficiency with which water was used in and around the home. An additional three statements were concerned with just how much water the managers felt people should be supplied with, relative to their demands.

Generally, the results of the first two statements suggest that the water managers do not consider that people either waste water or overuse it (Table 6-22). Although these results indicate an unwillingness to ration, a sizeable proportion of the managers (though by no means a majority) disagreed that people should be provided with all the water they demanded, except in the case of water for lawn irrigation (Table 6-23). Thus, there appears to be a definite and consistent reluctance to exact savings from water used for lawns. It is possible that the above perceptions and attitudes might be changed if data were made available suggesting just how much overwatering is done, and how much such peak use is costing in Alberta. The fact that the peak demands exist is discussed in the preceding chapter.

TABLE 6-22

PERCEPTION OF EFFICIENCY WITH WHICH RESIDENTIAL CONSUMERS USE WATER

Statements from Likert table	Percentage Distribution				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Generally it might be said that most people do not waste water	7.3	55.8	4.8	29.1	3.0
It is unlikely that most people overuse water in and around their homes.	4.3	57.9	9.8	26.2	1.8

TABLE 6-23

MANAGERS' PERCEPTIONS OF HOW MUCH WATER PEOPLE SHOULD BE SUPPLIED WITH

Statements from Likert table	Percentage Distribution				
	Strongly Agree	Agree.	Neutral	Disagree	Strongly Disagree
It is best to supply all the water demanded by people, irrespective of the difficulties of providing it.	2.5	29.4	14.7	46.6	6.7
People have a right to all the water they want.	3.0	37.8	12.2	40.9	6.1
Even if they are willing to pay more, people should only be allowed to use a certain amount of water to irrigate their lawns.	1.8	25.0	19.5	48.8	4.9

The consistency of perceptions and attitudes is again evident in that significant between group differences occur in the responses to all of the statements in Table 6-23, between those who agree that it is right to restrict consumption, and those who do not (Tables 6-24, 6-25, 6-26). The perception of rationing as acceptable over a short time also fits this dichotomy, with those who agree that restricting demand is acceptable tending to agree that rationing is also acceptable (Table 6-27).

TABLE 6-24

PERCEPTION BY ALBERTA WATER MANAGERS OF WHETHER IT IS RIGHT TO RESTRICT CONSUMPTION BY WHETHER OR NOT IT IS BEST TO SUPPLY ALL THE WATER DEMANDED BY PEOPLE.

Is it right to restrict consumption?	Best to supply all water demanded		
	Agree	Neutral	Disagree
Agree	13	9	46
Neutral	4	11	18
Disagree	31	4	21

Chi-square significant at .05

TABLE 6-25

PERCEPTION BY ALBERTA WATER MANAGERS OF WHETHER IT IS RIGHT TO RESTRICT CONSUMPTION BY WHETHER OR NOT PEOPLE HAVE A RIGHT TO ALL THE WATER THEY WANT

Is it right to restrict consumption?	People have a right to water		
	Agree	Neutral	Disagree
Agree	15	4	49
Neutral	10	9	15
Disagree	39	6	11

Chi-square significant at .05

TABLE 6-26

PERCEPTION OF WHETHER IT IS RIGHT TO RESTRICT CONSUMPTION BY WHETHER OR NOT PEOPLE SHOULD ONLY BE ALLOWED SO MUCH WATER FOR LAWN IRRIGATION

Is it right to restrict consumption?	Only allowed so much water		
	Agree	Neutral	Disagree
Agree	27	11	30
Neutral	7	16	11
Disagree	5	5	46

Chi-square significant at .05

TABLE 6-27

PERCEPTION OF WHETHER IT IS RIGHT TO RESTRICT CONSUMPTION BY WHETHER OR NOT SHORT TERM RATIONING IS AN ACCEPTABLE MEANS OF REDUCING CONSUMPTION

Is it right to restrict consumption?	Is rationing acceptable?		
	Agree	Neutral	Disagree
Agree	46	11	7
Neutral	16	15	4
Disagree	27	16	11

Chi-square acceptable at .05

The perception of rationing as acceptable is further affected by whether or not the community is perceived as able to pay for an expanded water supply system. A greater proportion of the respondents who agreed that it was best to supply all the water demanded by people also felt that their community was able to pay for expansions (Table 6-28). Although this difference occurred on only one of the statements pertinent to rationing, the tendency is notable if not conclusive.

TABLE 6-28

PERCEPTION OF WHETHER IT IS BEST TO SUPPLY ALL THE WATER DEMANDED BY PERCEPTION OF COMMUNITY'S ABILITY TO PAY FOR AN EXPANDED SYSTEM

	Ability to pay		
Supply all water?	Able	Undecided	Unable
Agree	34	13	3
Neutral	8	5	8
Disagree	44	15	22

Chi-square significant at .05

In summation, the argument appears to be quite strong that perceptions of management alternatives are strongly dependent upon very basic attitudes. The most significant example from this analysis is the pervasive influence of the attitude that it is not right to attempt to restrict a person's consumption of water.

WHAT THE PUBLIC EXPECTS

As was discussed in both Chapters 2 and 3, the perceptions and attitudes of the water manager might be changed or overidden by what he feels (or knows) the public expects from him. In the Likert tables, two statements were directed towards discovering how the water manager perceived what the public expected in terms of supply, two statements at what the public expected to pay for water, and one statement was directed to gaining an indication of whether or not the manager felt any pressure from the public to use water efficiently.

Eighty-seven percent of the respondents were in agreement with each other that the public expected unlimited supplies of water, and 75 percent felt the public expected enough to keep their lawns green in summer (Table 6-29). The discrepancy between the two figures is inexplicable, but the trend is similar.

TABLE 6-29

MANAGERS' PERCEPTIONS OF WHAT THE PUBLIC EXPECTS IN TERMS OF WATER SUPPLY

Statements from Likert table	Percentage Distribution				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The public expects unlimited supplies of water	11.8	75.2	6.8	6.2	-
People should be able to expect enough water to keep their lawns green in summer.	4.9	69.9	14.1	10.4	0.4

In terms of what the managers felt people were willing to pay, 65 percent indicated that people expect to receive water at a nominal price. However, 60 percent also felt that people would be willing to pay higher prices to continue receiving unlimited supplies of water (Table 6-30). Thus, the majority of managers do not seem to be able to conceive of people using less water, even if they have to pay more to obtain it. Moreover, these perceptions are apparently reflected in their pricing and supply policies, as documented in the fifth chapter.

TABLE 6-30

MANAGERS' PERCEPTIONS OF WHAT THE PUBLIC EXPECTS TO PAY FOR WATER

Statements from Likert table	Percentage Distribution				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The public expects to receive water at only a nominal price.	6.2	59.3	8.6	24.1	1.9
People are willing to pay higher prices to continue receiving unlimited supplies of water.	3.1	57.1	14.7	25.2	-

Responses to the question of whether or not managers in Alberta were expected to encourage the conservation of water were fairly evenly distributed in the middle ranges, with a slightly larger proportion feeling they were expected to encourage conservation (Table 6-31). Based upon the previously noted perceptions, attitudes, and policies though, it might be concluded that these feelings carry very little commitment.

TABLE 6-31

DISTRIBUTION OF RESPONSES TO THE STATEMENT:
"THE PUBLIC EXPECTS THE WATER DEPARTMENT
TO ENCOURAGE THE CONSERVATION OF WATER"

	Number	Percent
Strongly Agree	4	2.5
Agree	64	39.3
Neutral	49	30.1
Disagree	46	28.2
Strongly disagree	-	-
	163	100.0

SUMMARY

The perceptions, attitudes, and behaviour (both explicit and implicit) which have been documented to this point for Alberta water managers are typical of those of their North American counterparts. The majority of the managers surveyed are committed to providing unlimited supplies of water, and they give high priority to achieving that goal. Similarly, many of the managers are totally opposed to any attempts to restrict consumption, and do not consider it right to do so. Thus, as a general rule, water managers in Alberta tend to fit the stereotype put forth previously. They consider that water is essential, and that people need all the water they demand. Consequently, suggested policies which go against these perceptions and attitudes are rejected as either undesirable, ineffective, or unnecessary. Finally, increased prices alone do not seem totally objectionable. The attitudes of the managers appear to be that consumers are willing and able to pay more for expanded treatment and distribution systems; but, they are unwilling to, and should not have to, pay more for the water itself.

The need for factual information on management alternatives is also evident in this chapter. Perception of management alternatives appears to be based to a considerable extent upon basic attitudes, rather than upon factual evidence. A large number of the water managers are also neutral or undecided on many of the issues, and a relevant information program might provide some basis for rational decisions or, at least, consideration of the alternatives. Moreover, the magnitude of the attitudes, which was measured by how strongly the respondent agreed or disagreed with a particular statement or issue, was not usually extreme. This also indicates some potential for attitude change.

The central theme in this chapter has been that of the consistency of perceptions and attitudes, and how they probably affect behaviour. In the following chapter, the problem will be to document whether or not perceptions and attitudes have affected decisions on residential water supply, or if the perceptions, attitudes, and behaviour stem from past experience with the use of management alternatives and with residential water supply and demand problems.

CHAPTER 7

EXPERIENCE, PERCEPTIONS, ATTITUDES, BEHAVIOUR

INTRODUCTION

In Chapter 5 the physical inventory portion of the research was documented, and in Chapter 6, the behavioural portion of the research was presented. Following, in terms of the objectives listed in Chapter 4, is the review of the role that perceptions and attitudes play in the choice of and use of management alternatives. In addition, an attempt is made to determine the factors which underly the perceptions and attitudes of water managers in Alberta.

It may be recalled from the discussion in Chapter 2 that perceptions and attitudes essentially stem from past experience and knowledge. Behaviour, in turn, is dependent upon perceptions and attitudes. Subsequently, the approach taken in the following analysis is to note how past experience with metering, different pricing schedules, shortages, and rationing have affected the perceptions and attitudes of water managers, and how these perceptions and attitudes have affected behaviour as it relates to the use of management alternatives.

METERING

Experience with the use of meters resulted in different attitudes towards the need for and utility of water conservation, rationing, and pricing policies. The data analysis, however, did not reveal any relationship between experience with meters and the manner in which metering itself is perceived.

Significant differences in responses occurred between the two groups who do and do not meter on one of the two Likert statements related to attitudes toward the efficient use of water in general, and on one of the two statements concerned with the effectiveness of conservation measures. Those managers with meters had a greater tendency to agree with the idea that there is no need to conserve water in Alberta than did those managers who do not meter (Table 7-1). The former group also had a greater tendency to reject the utility of using water efficiently, to the extent that they disagreed that reduced consumption would reduce the costs of supply (Table 7-2).

TABLE 7-1

EXPERIENCE OF RESIDENTIAL WATER MANAGERS WITH METERING BY THEIR RESPONSES TO THE STATEMENT: "THERE IS NO NEED TO CONSERVE WATER, AT LEAST IN ALBERTA BECAUSE THERE IS PLENTY OF WATER FOR EVERYBODY"

Residential Metering	No Need to Conserve Water		
	Agree	Neutral	Disagree
Used	32	23	44
Not Used	14	4	38

Chi-square significant at .01

TABLE 7-2

EXPERIENCE OF RESIDENTIAL WATER MANAGERS WITH METERING BY THEIR RESPONSES TO THE STATEMENT: "IF YOU COULD REDUCE THE CONSUMPTION OF WATER PER HOUSEHOLD, YOU COULD REDUCE THE COSTS OF SUPPLYING THE WATER"

Residential Metering	Reduce costs of supply		
	Agree	Neutral	Disagree
Used	42	9	48
Not Used	37	5	14

Chi-square significant at .01

The above tendencies are consistent with what the managers believe the public expects from them in terms of conservation. While many managers do feel they are expected to conserve water, those who use meters had a significant tendency to disagree that the public expected this from them (Table 7-3).

TABLE 7-3

EXPERIENCE OF RESIDENTIAL WATER MANAGERS WITH METERING BY THEIR RESPONSES TO THE STATEMENT: "THE PUBLIC EXPECTS THE WATER DEPARTMENT TO ENCOURAGE THE CONSERVATION OF WATER"

Residential Metering	Expected to conserve water		
	Agree	Neutral	Disagree
Used	35	37	28
Not Used	31	11	13

Chi-square significant at .05

The two Likert statements concerned with whether or not people waste or overuse water were intended to gain an indication of how willing managers are to ration. The managers of metered community systems tended to agree that people do not waste water (and thereby, would be less willing to ration) while managers of communities with unmetered systems disagreed to a significant degree (Tables 7-4 and 7-5).

TABLE 7-4

EXPERIENCE OF RESIDENTIAL WATER MANAGERS WITH METERING BY THEIR RESPONSES TO THE STATEMENT: "GENERALLY, IT MIGHT BE SAID THAT MOST PEOPLE DO NOT WASTE WATER"

Residential Metering	People do not waste water		
	Agree	Neutral	Disagree
Used	70	6	25
Not Used	30	1	24

Chi-square significant at .05

TABLE 7-5

EXPERIENCE OF RESIDENTIAL WATER MANAGERS WITH METERING BY THEIR RESPONSES TO THE STATEMENT: "IT IS UNLIKELY THAT MOST PEOPLE OVERUSE WATER IN AND AROUND THEIR HOMES"

Residential Metering	Unlikely that people overuse water		
	Agree	Neutral	Disagree
Used	70	6	25
Not Used	27	8	19

Chi-square signficant at .05

The propensity of managers in metered communities to underrate the value of management alternatives extends to the perception of different pricing policies. The managers of metered systems had a significantly greater tendency to disagree on two of the three Likert statements related to practical approaches to pricing - that people should pay more for water used in their swimming pools (Table 7-6) and for lawn water (Table 7-7).

TABLE 7 - 6

EXPERIENCE OF RESIDENTIAL WATER MANAGERS WITH METERING BY THEIR RESPONSES TO THE STATEMENT: "PEOPLE SHOULD PAY MORE FOR WATER USED TO FILL THEIR SWIMMING POOLS"

Residential Metering	People should pay more		
	Agree	Neutral	Disagree
Used	27	20	52
Not Used	31	10	14

Chi-square significant at .001

TABLE 7-7

EXPERIENCE OF RESIDENTIAL WATER MANAGERS WITH METERING BY THEIR RESPONSES TO THE STATEMENT: "PEOPLE SHOULD PAY MORE FOR WATER WHICH THEY USE TO IRRIGATE THEIR LAWNS"

Residential Metering	People should pay more		
	Agree	Neutral	Disagree
Used	15	23	62
Not Used	20	6	29

Chi-square significant at .01

The group of managers using meters also perceived the effectiveness of pricing as a means of reducing consumption in a manner consistent with the above responses. Although the majority of water managers do consider pricing to be effective, the managers of metered community systems had a greater tendency to respond that raising the price of water would be ineffective in reducing consumption, even initially (Table 7-8).

TABLE 7-8

EXPERIENCE OF RESIDENTIAL WATER MANAGERS WITH METERING BY THE MANNER IN WHICH THE EFFECT OF PRICE INCREASES ON REDUCING DEMAND IS PERCEIVED.

Residential Metering	Effectiveness of increasing price		
	Effective	Undecided	Ineffective
Used	51	17	32
Not Used	40	7	8

Chi-square significant at .05

SCHEDULE TYPE

Experience with different types of pricing schedules results in some significant between group differences in perceptions and attitudes related to different pricing policies and their effectiveness. Between-group differences occurred in the responses to one of the two abstract Likert statements related to how water should be priced, and on two of the three statements related to the practicalities of conservation pricing policies. The relevant abstract statement concerned the proposal that people should only be allowed a certain minimum amount of water, and should have to pay extra for each unit used above that minimum. Water managers working with DBR schedules responded in a manner reflecting the philosophy of DBR, and tended to disagree that price per unit should increase if higher volumes of water are used (Table 7-9).

TABLE 7-9

EXPERIENCE OF WATER MANAGERS WITH DIFFERENT PRICING SCHEDULES BY THEIR RESPONSES TO THE STATEMENT: "EVERYONE SHOULD BE ALLOWED A CERTAIN STANDARD MINIMUM QUANTITY OF WATER TO COVER BASIC NEEDS AND PEOPLE WHO USE MORE THAN THAT SHOULD PAY MORE FOR EACH UNIT OF WATER ABOVE THAT MINIMUM"

Schedule Type	People should pay more		
	Agree	Neutral	Disagree
Flat rate	41	11	7
DBR	22	9	8
Conservation	42	4	3

Chi-square significant at .05

Respondents working with flat rate schedules tended to assign more significance to price as an effective means of reducing consumption than did water managers working with pricing schedules. Managers in towns which utilize flat rate schedules agree, for the most part, that price increases would be effective in reducing consumption both after the initial increase (Table 7-10), and in keeping consumption down in the long run (Table 7-11).

TABLE 7-10

EXPERIENCE OF WATER MANAGERS WITH DIFFERENT PRICING SCHEDULES BY THEIR PERCEPTION OF THE EFFECTIVENESS OF PRICE INCREASES IN REDUCING DEMAND

Schedule Type	Price Increases Effective	Undecided	Ineffective
Flat Rate	42	10	8
DBR	22	6	11
Conservation	23	7	19

Chi-square significant at .05

TABLE 7-11

EXPERIENCE OF WATER MANAGERS WITH DIFFERENT PRICING SCHEDULES BY THE PERCEIVED EFFECT OF PRICES IN KEEPING CONSUMPTION LEVELS DOWN IN THE LONG RUN

Schedule Type	Would consumption stay down? Yes	Undecided	No
Flat Rate	26	14	23
DBR	12	4	22
Conservation	11	7	31

Chi-square significant at .05

Managers with flat rate schedules also accept that metering is effective in the long run reduction of consumption. DBR users mainly felt it would return to normal, but they were relatively divided on the issue compared to users of conservation schedules, 65 percent of whom felt consumption would return to normal after metering had been used for a year or two (Table 7-12).

TABLE 7-12

EXPERIENCE OF WATER MANAGERS WITH DIFFERENT PRICING SCHEDULES BY THE PERCEIVED EFFECT OF METERING IN KEEPING CONSUMPTION LEVELS DOWN IN THE LONG RUN

Schedule Type	Would consumption stay down?		
	Yes	Undecided	No
Flat Rate	21	16	25
DBR	18	3	16
Conservation	32	7	10

Chi-square significant at .01

PAST SHORTAGES AND RATIONING

It appears that experience with past water shortages has had little impact upon the perceptions and attitudes of water managers. Those managers who have experienced shortages do, however, have a much greater tendency to reject the argument that people do not waste water (Table 7-13), or similarly, that people do not overuse water (Table 7-14).

TABLE 7-13

EXPERIENCE OF WATER MANAGERS WITH DIFFERENT PRICING SCHEDULES BY THEIR RESPONSES TO THE STATEMENT: "THE PUBLIC EXPECTS THE WATER DEPARTMENT TO ENCOURAGE THE CONSERVATION OF WATER"

Schedule Type	Expected to conserve water?		
	Agree	Neutral	Disagree
Flat Rate	34	12	15
DBR	14	9	15
Conservation	17	21	11

Chi-square significant at .05

TABLE 7-14

EXPERIENCE OF WATER MANAGERS WITH THE OCCURRENCE OF WATER SHORTAGES BY THEIR RESPONSES TO THE STATEMENT: "GENERALLY, IT MIGHT BE SAID THAT MOST PEOPLE DO NOT WASTE WATER"

Shortages	People do not waste water		
	Agree	Neutral	Disagree
Occurred	34	3	29
Did not occur	70	5	23

Chi-square significant at .05

Managers who have experienced shortages also have a greater tendency to feel that reduced consumption will yield benefits in the form of reduced water supply costs (Table 7-15).

TABLE 7-15

EXPERIENCE OF WATER MANAGERS WITH THE OCCURRENCE OF WATER SHORTAGES BY THEIR RESPONSES TO THE STATEMENT: "IF YOU COULD REDUCE THE CONSUMPTION OF WATER PER HOUSEHOLDS, YOU COULD REDUCE THE COSTS OF SUPPLYING THE WATER"

	Reduce costs of supply		
Shortages	Agree	Neutral	Disagree
Occurred	35	1	30
Did not occur	47	14	35

Chi-square significant at .05

Past shortages do not appear to have had any influence upon the behaviour of water managers. Shortages have not spurred water managers to undertake price increases, pricing schedule changes, metering, leak detection programs, or any other programs or policies which might lead to the more efficient use of water.

Water managers who have experienced the need to ration exhibit more pronounced differences in their perceptions, attitudes, and behaviour compared to those who have experienced shortages but have not had to ration. As noted in Chapter 6, few managers see rationing as an acceptable long run alternative to control consumption levels and demand patterns. However, experience with rationing does result in a favourable impression of rationing as a short-term alternative (Table 7-16). Whether these favourable perceptions stem from successful experiences with rationing or with the manager having used it, upon cognitive dissonance, experience does appear to enhance its perceived attractiveness as a management alternative. This enhancement has occurred to the extent that managers, when grouped by river basin, show significant between group differences in the per-ception of rationing as acceptable in the long run (Table 7-17). The tendency to see rationing as acceptable is particularly evident in the South Saskatchewan basin, where both the need for rationing and the amount of use are greatest due to the high peak to average demand ratios and high demand levels overall.

TABLE 7-16

EXPERIENCE OF WATER MANAGERS WITH RATIONING BY THEIR PERCEPTION OF ITS ACCEPTABILITY FOR SHORT PERIODS OF USE

	Is rationing acceptable?		
Rationing	Yes	Undecided	No
Used	35	3	10
Not Used	55	18	33

Chi-square significant at .05

Consistent with the tendency of managers experienced with rationing to view it favourably is the greater tendency of that group to agree that people waste water (Table 7-18) and overuse it (Table 7-19).

TABLE 7 - 17

LOCATION OF WATER MANAGERS ACCORDING TO RIVER BASINS BY THEIR PERCEPTION OF RATIONING AS ACCEPTABLE FOR LONG PERIODS OF USE

River Basin	Is rationing acceptable?	
	Yes	No
South Saskatchewan	13	21
Red Deer	8	22
North Saskatchewan	20	41
Peace/Athabasca	2	25

Chi-square significant at .05

TABLE 7-18

EXPERIENCE OF WATER MANAGERS WITH RATIONING BY THEIR RESPONSES TO THE STATEMENT: "GENERALLY, IT MIGHT BE SAID THAT MOST PEOPLE DO NOT WASTE WATER"

Rationing	People do not waste water		
	Agree	Neutral	Disagree
Used	23	2	24
Not Used	81	6	28

Chi-square significant at .01

In Chapter 6, it was noted that the majority of managers accepted pricing as effective in reducing consumption initially, but only 34 percent felt it to be effective

TABLE 7-19

EXPERIENCE OF WATER MANAGERS WITH RATIONING BY THEIR RESPONSES TO THE STATEMENT: "IT IS UNLIKELY THAT MOST PEOPLE OVERUSE WATER IN AND AROUND THEIR HOMES"

	People do not overuse water		
Rationing	Agree	Neutral	Disagree
Used	23	3	23
Not Used	79	13	22

Chi-square significant at .05

in the long run. Of the small group which perceived pricing as effective in the long run, a significantly large proportion had experienced rationing (Table 7-20). Thus, there appears to be a general acceptance of the value of management alternatives on the part of those managers who have experienced rationing. However, these perceptions and attitudes are not extrapolated to the complete range of water supply problems. Problems with rationing do not induce greater awareness of the desirability of controlling demand patterns per se, or affect attitudes toward how water should be priced.

Experience with rationing also appears to have had an impact upon the behaviour of water managers. A significantly greater proportion of the water supply system expansions in Alberta have been undertaken or are being planned in communities which have had to ration (Tables 7-21 and

TABLE 7-20

EXPERIENCE OF WATER MANAGERS WITH RATIONING BY THEIR PERCEIVED EFFECT OF PRICE IN KEEPING CONSUMPTION DOWN IN THE LONG RUN

Rationing	Would consumption stay down?		
	Yes	Undecided	No
Used	25	4	19
Not Used	32	24	60

Chi-square significant at .01

7-22). Although a large number of municipalities have initiated expansions without undergoing either shortages or rationing, it is suggested by the data presented in Table 7-21 that many expansions result from the need to ration, and therefore are likely to be decided upon in a crisis situation. Consequently, the use of management alternatives to put off expansions into the future is either too late, or does not receive consideration.

TABLE 7-21

THE USE OF RATIONING IN MUNICIPALITIES BY WHETHER OR NOT EXPANSIONS HAVE BEEN UNDERTAKEN.

Rationing	Expansions	
	Undertaken	Not Undertaken
Used	35	14
Not Used	45	72

Chi-square significant at .001

TABLE 7-22

THE USE OF RATIONING IN MUNICIPALITIES BY WHETHER OR NOT THERE ARE PLANS FOR FUTURE EXPANSIONS.

Rationing	Expansions	
	Planned	Not Planned
Used	28	18
Not Used	35	82

Chi-square significant at .001

The need to ration is also associated with the hiring of engineering consultants (Table 7-23) and the completion of demand projections (Table 7-24). These relationships follow axiomatically from the greater tendency to undertake expansions since most municipalities must hire outside expertise for such projects, for the size of the municipality usually does not warrant the maintenance of an engineering staff.

TABLE 7-23

THE USE OF RATIONING IN MUNICIPALITIES BY THEIR USE OF ENGINEERING CONSULTANTS

Rationing	Consultants	
	Used	Not Used
Used	34	12
Not Used	54	60

Chi-square significant at .01

TABLE 7-24

THE USE OF RATIONING IN MUNICIPALITIES BY WHETHER OR NOT DEMAND PROJECTIONS HAVE BEEN COMPLETED

Rationing	Demand Projections Completed	Demand Projections Not Completed
Used	21	26
Not Used	24	92

Chi-square significant at .01

PAST EXPANSIONS

Even with the use of management alternatives, capacity expansions are often necessary in a growing community. Consequently, it would be fallacious to suggest that perceptions and attitudes could generally have an impact upon whether or not expansions have taken place, unless a detailed analysis of each decision to expand is undertaken. However, it is of interest to note the associations between perceptions and attitudes and experience with expansions. Some of the perceptions and attitudes may well stem from the experience of expanding, and some may have contributed to the decision to expand, particularly the basic attitude that it is not right to restrict consumption. In the data analysis, it was found that the group of water managers experienced in expansions differed significantly from the group which had not had expansions in the following ways: on the two Likert statements related to attitudes toward conservation (Table 7-25), and on one of the two

Likert statements related to the effectiveness of conservation measures (Table 7-26). In both cases, the managers who have undertaken expansions reject the theoretical value of conserving water and the possibility that savings might be associated with attempts to alter the demand for water.

TABLE 7-25

EXPERIENCE OF WATER MANAGERS WITH PAST EXPANSIONS BY THEIR RESPONSES TO THE STATEMENT: "USING AS LITTLE WATER AS POSSIBLE IS A WORTHWHILE GOAL FOR ANY WATER DEPARTMENT"

	Using little water worthwhile		
Expansions	Agree	Neutral	Disagree
Undertaken	17	16	46
Not Undertaken	31	21	33

Chi-square significant at .05

TABLE 7-26

EXPERIENCE OF WATER MANAGERS WITH PAST EXPANSIONS BY THEIR RESPONSES TO THE STATEMENT: "IF YOU COULD REDUCE THE CONSUMPTION OF WATER, YOU COULD REDUCE SEWAGE TREATMENT COSTS SIGNIFICANTLY"

	Reduce Costs		
Expansions	Agree	Neutral	Disagree
Undertaken	24	15	36
Not Undertaken	35	22	25

Chi-square significant at .05

A significant between group difference also occurs on the key statement in the Likert table related to willingness to ration, that of whether people should only be allowed a certain amount of water to irrigate their lawns. Over 63 percent of the managers of expanded systems disagreed with the above idea (Table 7-27).

TABLE 7-27

EXPERIENCE OF WATER MANAGERS WITH PAST EXPANSIONS BY THEIR RESPONSES TO THE STATEMENT: "EVEN IF THEY ARE WILLING TO PAY MORE, PEOPLE SHOULD ONLY BE ALLOWED TO USE A CERTAIN AMOUNT OF WATER TO IRRIGATE THEIR LAWNS"

Past Expansions	Should only be allowed so much water		
	Agree	Neutral	Disagree
Undertaken	13	16	50
Not Undertaken	31	16	38

Chi-square significant at .05

Those water managers in municipalities with expanded water supply systems were also inclined to suggest that people in their communities were able to pay for expanded systems (Table 7-28). Thus, those managers who argue that people are willing and able to pay for expansions are the ones who are undertaking the expansions. This reinforces the argument that managers feel people are willing to pay more for expanded systems but not for the water itself.

TABLE 7-28

EXPERIENCE OF WATER MANAGERS WITH PAST EXPANSIONS BY THEIR PERCEPTION OF THE ABILITY OF THE COMMUNITY TO PAY FOR EXPANSIONS

	Ability to pay		
Expansions	Able	Undecided	Unable
Undertaken	53	11	10
Not Undertaken	34	23	24

Chi-square significant at .001

A significantly larger proportion of communities which have undergone expansions have also had price changes (Table 7-29). It would seem that expansions have induced price increases, although these increases have not resulted in generally higher prices relative to systems which have not been expanded (Table 7-30).

TABLE 7-29

CROSS TABULATION OF COMMUNITIES WHICH HAVE UNDERTAKEN EXPANSIONS BY THOSE WHICH HAVE INCREASED PRICE

	Price	
Expansions	Increased	Not Increased
Undertaken	29	49
Not Undertaken	15	70

Chi-square significant at .01

TABLE 7-30

CROSSTABULATION OF COMMUNITIES WHICH HAVE UNDERTAKEN EXPANSIONS BY THE AMOUNT OF THE MONTHLY WATERBILL IN THOSE COMMUNITIES

	Amount of Waterbill		
Expansions	0-5.00	5.01-10.00	10.01+
Undertaken	36	37	3
Not Undertaken	40	34	5

Chi-square not significant

SUMMARY

It is evident from the preceding analysis that the links between perceptions and attitudes and behaviour, as identified in this research project, are tenuous and inconclusive. It is possible that the lack of understanding of management alternatives has resulted in a number of inconsistencies. At the same time, however, the inconsistencies and anomalies described above probably reflect the peculiar role of "the image" and cognitive dissonance in determing how water managers evaluate management alternatives, particularly when combined with experience on the part of the water managers.

Nevertheless, a number of interesting relationships were brought out in the foregoing pages. Water managers experienced with metering consistently disagreed that any value lay with metering as a means of reducing or controlling demand for residential water. The water managers experienced with metering also tended to reject the possibility that price would be similarly effective. It is most probable, in this case, that the respondents were relying on their own experience with metering, and had not found it effective. However, it does not appear that the water managers recognized that the price attached to their metering program was too low to induce reduced consumption.

At the same time, it is interesting to note that those water managers dealing with flat rate schedules recognized the waste of water in their communities, and felt that pricing and metering would be effective. To this extent, experience has an obvious affect on perceptions and attitudes.

The only experience which had an immediate and direct affect on perceptions, attitudes, and behaviour was the need to ration. Those water managers experienced with rationing felt it to be an acceptable alternative in making demand fit supplies, and similarly, acknowledged the "overuse" of water in their communities. However, experience with one alternative does not affect the perceptions of other alternatives, and pricing and metering are still considered to be ineffective.

Rationing affects behaviour to the extent that it induces expansions. It also appears that following expansions the water managers' perceptions and attitudes about rationing, wasting water, and so forth, tend to change to reflect the current water supply and demand situation in the municipality.

CHAPTER 8

SUMMARY AND CONCLUSIONS

In the first three chapters of this thesis, a number of basic assumptions were discussed which relate to the role which perceptions and attitudes of water managers play in influencing the choice of and use of management alternatives. It is apparent from the preceding analysis that for the most part these general assumptions apply to the situation in Alberta. Generally speaking, management alternatives are not used in a conscious manner in Alberta to influence the demand for residential water. However, the opportunities for the use of these alternatives are numerous at present, and will probably become increasingly so in the future. Nevertheless, the data analysis does provide evidence that managerial perceptions and attitudes are a major impediment to the use of management alternatives in Alberta. Certainly, the thrust of the research has been focused on only one of several aspects of the decision making process relating to the solution of water supply and demand problems. However, it has been argued within the thesis that political considerations and public demands become part of the water manager's image, and the behaviour of the water manager is reflected in the present degree of use of these alternatives.

In Alberta, the per capita demand for residential water has been increasing, and it is quite likely that water shortages may become more numerous and rationing increasingly common. If this does prove to be the case, the costs of expansions will increase the tax burden on many municipalities. The problem will become more acute when additional water supplies become increasingly scarce as the existing reserves are allocated to various uses.

At present, demand restrictions are used only in crisis situations, and metering and pricing are ineffectively utilized. Indeed, most of the water managers who responded to the survey were reluctant to concede that even if the need to rationalize water demands did exist, that management alternatives would be effective.

It is evident from the responses of the water managers that one of the most significant problems is that many information gaps exist on the subject of management alternatives. For example, the implications of pricing and metering policies (both favourable and otherwise) do not appear to be clearly understood. Moreover, there appears to be little recognition of the fact that water is wasted and inefficiently used in the realm of residential supply. At the same time, many water managers appear to be well aware of the management alternatives available, but still do not employ them. It is evident that the perceptions and attitudes of the water managers do maintain the gap between the available knowledge on management alternatives and the actual application of such alternatives.

The need to adopt alternatives which will contribute to the more efficient use of water may be more critical in parts of the western United States than it is in Alberta at present. Nevertheless, the situation in Alberta is mirrored in the general observations put forth in Chapter 3 which relate to the use of management alternatives in meeting residential water demand.

A considerable amount of detailed research on the various aspects of the decision making process relating to residential water will be required before the process is entirely understood. For example, a small amount of information was collected in this research project on consulting firms and the background of the water manager. None of the data proved to be significant in the analysis, but it may be that insufficient information was collected. In addition, it is most likely that detailed analysis of the political aspects of water management would prove to be of value in understanding why management alternatives have not been effectively utilized in controlling the demand for residential water.

It is obvious, of course, that the present practice of fitting residential water supplies to demand will not change until the need to achieve efficiency in residential water management is recognized. It is also obvious that decision makers have not recognized as yet that the need exists, and may not until the demand pressure put upon the supply increases considerably. Nevertheless, of all

Canadian provinces, it is most likely that Alberta is the province in which agricultural and industrial growth, and related urban growth, may be faced with the problem of scarce water supplies. Perhaps the alternatives should be evaluated before the problem becomes a severe one. Such an evaluation should permit the use of the most economic combination of management and construction alternatives to meet the demand for residential water in Alberta. It should also contribute to the most efficient allocation of available water supplies to different uses throughout the province.

BIBLIOGRAPHY

ALBERTA DEPARTMENT OF THE ENVIRONMENT. Alberta Waterworks, Sewerage, and Swimming Pool Survey, 1971. Edmonton: Government of Alberta, January, 1972.

ALBERTSON, MAURICE L., L. SCOTT TUCKER, AND DONALD C. TAYLOR, ed. Treatise on Urban Water Systems. Colorado: Colorado State University, 1971.

ALLPORT, G. W. "Attitudes in the History of Social Psychology", in Attitudes, ed. Marie Jahoda and Neil Warren. Great Britain: Penquin Books, 1966, pp. 15-21.

BAUMANN, DUANE D. The Recreational Use of Domestic Water Reservoirs: Perception and Choice, Department of Geography Research Paper No. 121. Chicago: University of Chicago, 1969.

BECKWITH, HOMER E. "Economics of Leak Surveys", Journal AWWA, Vol. 56, No. 5 (1964), pp. 575-578.

BOULDING, KENNETH E. "Forward", in Image and Environment, ed. Roger M. Downs and David Stea. Chicago: Aldine, 1973.

BOULDING, KENNETH E. The Image. Ann Arbour: University of Michigan, 1956.

BRUCE, J. P., and D. E. L. MAASLAND. Water Resources Researchin Canada, Science Secretariat, Special Study No. 5. Ottawa: Queen's Printer, 1968.

BULTENA, GORDON L., and MARVIN J. TAVES. "Changing Wilderness Images and Forestry Policy", Journal of Forestry, Vol. 59 (March, 1961), pp. 167-171.

BUNTING, T., and V. GALLANT. "The Environmental Grab Bag", in Geographical Inter-University Resource Management Seminar, Paper No. 6, ed. J. Leurs. Waterloo Lutheran University, January 1971, pp. 19-43.

BURTON, IAN. "The social role of perception and attitude studies", in Perceptions and Attitudes in Resources Management, Resource Paper #2, ed. W. L. Derrick Sewell and Ian Burton. Ottawa: Information Canada, 1971, pp. 1-6.

BURTON, T. L., and G. E. CHERRY. Social Research Techniques for Planners. London: George, Allen, and Unwin, 1970.

CASEY, MAURICE. *Comparison Study of Water and Sewerage Rates of Major Canadian Cities, 1972*. City of Edmonton, Xerox.

CAMPBELL, THOMAS H., and ROBERT O. SYLVESTER, ed. *Water Resources Management and Public Policy*. Seattle: University of Washington Press, 1968.

CANADIAN COUNCIL OF RESOURCE MINISTERS. *A Survey of Governmental Charges for the Use of Water as a Resource*. Ottawa: Canadian Council of Resource Ministers, September, 1969.

CANADIAN COUNCIL OF RESOURCE MINISTERS. *The Administration of Water Resources in Canada*. Montreal: Canadian Council of Resource Ministers, 1968.

CIRIACY - WANTRUP, S. V. *Resource Conservation: Economics and Policies*. California: University of California Press, 1952.

COCHRAN, ANITA. *A Selected, Annotated Bibliography on Natural Hazards*, Natural Hazard Research Working Paper No. 22. U.S.A.: University of Colorado, 1973.

DAVIS, ROBERT K. *The Range of Choice in Water Management: A Study of Dissolved Oxygen in the Potomac Estuary*. Baltimore: RFF, Johns Hopkins, 1968.

DEPARTMENT OF MUNICIPAL AFFAIRS. *Province of Alberta, Municipal Statistics for Year Ended December 31, 1971*. Edmonton: Queen's Printer, 1973.

DIETRICH, BERND H., and J. M. HENDERSON. *Urban Water Supply Conditions & Needs in 75 Developing Countries*, World Health Organization Public Health Paper No. 23. Geneva: WHO, 1963.

FESTINGER, LEON. *A Theory of Cognitive Dissonance*, New York: Row-Peterson, 1957.

FLACK, J. ERNEST. "Future Trends in Water Use", in *Treatise On Urban Water Systems*, ed. M. L. Albertson, L. S. Tucker, and D. C. Taylor. Colorado: Colorado State University, 1971. pp. 755-761.

FLACK, J. ERNEST. "Meeting Future Water Requirements Through Reallocation", *Journal AWWA*, Volume 59, No. 11 (1967), pp. 1340-1349.

FORECASTING MUNICIPAL WATER REQUIREMENTS, Vol. I, The Main II System, Office of Water Resources Research, U.S. Department of the Interior. Columbia, Maryland: Hittman and Associates Inc., September, 1969.

FREUND, JOHN E. Modern Elementary Statistics, New Jersey: Prentice Hall, 1967.

FRISTOE, CHARLES W., et al. Applied Criteria for Municipal Water Rate Structures. Springfield, Va.: National Technical Information Service, 1971.

GOULD, PETER. "Is Statitix Inferens the Geographical Name for a Wild Goose", Economic Geography, Vol. 46, No. 2 (Supplement, June, 1970), pp. 439-448.

GREENE, ROBERT L. Guidelines for Investment & Pricing Decisions of Municipally Owned Water Utilities, Public Finance Monograph Series #2, College of Business Administration. Georgia: University of Georgia, 1970.

GRIMA, ANGELO P. Residential Water Demand: Alternative Choices for Managment, Department of Geography Research Publication No. 7. Toronto: University of Toronto Press, 1972.

GYSI, MARSHALL. The Long Run Effects of Water Pricing Policies. New York: Cornell University, 1971.

GYSI, MARSHALL. "Flexible Pricing in Water Supply Planning - for Flexible Engineers", Water Resources Bulletin, Vol. 8, No. 5 (Oct., 1972), pp. 957-964.

GYSI, MARSHALL. "The Effect of Price on Long Run Water Supply Benefits", Water Resources Bulletin, Vol. 7, No. 3 (June, 1971), pp. 521-528.

HANKE, STEVE H., and J. ERNEST FLACK. "Effects of Metering Urban Water", Journal AWWA, Vol. 60, No. 12 (1968), pp. 1359-1365.

HANSSEN, KENNETH. "The Federal Declaratory Power Under the British North America Act", in Constitutional Aspects of Water Management, Vol. 1, ed. Dale Gibson, Agassiz Centre of Water Studies. Winnipeg: University of Manitoba, 1968.

HAVEMAN, ROBERT H. Water Resource Investment and the Public Interest, Tennessee: Vanderbilt University Press, 1965.

HENNIGAN, ROBERT D. "Urban (Municipal) Water Management", in Proceedings of the Annual Meeting of the AWRA, 4th. Illinois: AWRA, 1968, pp. 716-723.

HIRSHLEIFER, JACK, JAMES C. DE HAVEN, and JEROME W. MILLIMAN. Water Supply: Economics, Technology, and Policy. Chicago: University of Chicago Press, 1960.

HITTMAN AND ASSOCIATES, INC. Price, Demand, Cost, and Revenues in Urban Water Utilities, HIT 474. Columbia, Md: Hittman and Associates, Inc., 1970.

HOWE, CHARLES W., and F. P. LINAWEAVER, JR. "The Impact of Price in Residential Water Demand and its Relation to System Design and Price Structure". Water Resources Research Journal, Vol. 3 #1 (1967), pp. 13-32.

HOWE, CHARLES W. "Municipal Water Demands", in Forecasting the Demands for Water, Policy and Planning Branch, Department of Energy, Mines, and Resources, ed. W. R. Derrick Sewell and Blair T. Bower. Ottawa: Queen's Printer, 1968, pp. 43-84.

HOWE, CHARLES W. "Water Pricing in Residential Areas", Journal AWWA, Vol. 64, No. 5 (May, 1968), pp. 497-501.

JAMES, DOUGLAS L., and ROBERT R. LEE. Economics of Water Resources Planning. Toronto: McGraw-Hill, 1971.

JARRETT, HENRY, ed. Environmental Quality in a Growing Economy. Baltimore: Johns Hopkins for Resources for the Future 1966.

KATES, ROBERT W. Hazard and Choice Perception in Flood Plain Management, Department of Geography Research Paper No. 78. Chicago: University of Chicago, 1962.

KELLOW, RICHARD L. A Study of Residential Water Use in Calgary. Edmonton, Alberta: Unpublished Masters Thesis, Department of Agricultural Economics and Rural Sociology, University of Alberta, Spring, 1970.

KNAPP, JOHN L. The Economics of Industrial Water Use in Alberta: Quantitative and Qualitative Assessment. Unpublished Master's Thesis, Department of Economics, University of Alberta, Edmonton, Alberta, 1973.

KNEESE, ALLEN V., and STEPHEN C. SMITH, ed. Water Research. RFF, Baltimore: Johns Hopkins, for Resources for the Future, 1966.

KUIPER, EDWARD. Water Resources Development: Planning, Engineering and Economics. Toronto: Butterworths, 1965.

LAYCOCK, ARLEIGH H. "Water", in Canada: A Geographical Interpretation, Educational Edition, ed. John Warkentin. Toronto: Methuen, for the Canadian Association of Geographers, 1970, pp 112-136.

LAZERWITZ, BERNARD. "Sampling Theory and Procedures", in Methodology in Social Research, ed. Hubert M. Blalock, Jr., and Ann B. Blalock. Toronto: McGraw-Hill, 1968, pp. 278-328.

LEE, TERENCE R. Residential Water Demand and Economic Development, Department of Geography Research Publication No. 2. Toronto: University of Toronto Press, 1969.

LINAWEAVER, F. PIERCE, JR., and JOHN C. GEYER. "Use of Peak Demands in Determination of Residential Rates". AWWA, Vol. 56, No. 4 (1964), pp. 403-410.

LINAWEAVER, F. PIERCE, JR., J. C. GEYER, and J. B. WOLFF. A Study of Residential Water Use. Washington, D.C.: GPO, 1967.

LOEHMAN, EDNA, and ANDREW WHINSTON. "A new theory of pricing and decision making for public investment", Bell Journal of Economics & Management Science, Vol. 2, No. 2 (Autumn, 1971), pp. 606-625.

LOWENTHAL, DAVID, and HUGH C. PRICE "English Landscape Tastes", The Geographical Review, Vol. 55, No. 4 (April, 1965), pp. 188-222.

LOWENTHAL, DAVID. "Geography, Experience, and Imagination: Towards a Geographical Epistemology", Annals AAG, Vol. 51 (1961), pp. 241-260.

LOWENTHAL, DAVID, and HUGH C. PRINCE. "The English Landscape", The Geographical Review, Vol. 54, No. 3 (July, 1964), pp. 309-346.

LOWENTHAL, DAVID. "Assumptions Behind the Public Attitudes", in Environmental Quality in a Growing Economy, ed. Henry Jarrett. Baltimore: Johns-Hopkins, for Resources for the Future, 1966, pp. 128-137.

LUCAS, ROBERT C. "Wilderness Perception and Use: The Example of the Boundary Waters Canoe Area", Natural Resources Journal, Vol. 3, No. 3 (1964), pp. 394-411.

LYNCH, KEVIN. The Image of the City, Massachusetts: M.I.T. Press, 1960.

MACIVER, IAN. Urban Water Supply Alternatives: Perception and Choice in the Grand Basin, Ontario, Department of Geography Research Paper No. 126. Chicago: University of Chicago, 1970.

MANN, PATRICK. "The Political Influence of Residential Consumers on Water Rates", Water Resources Bulletin, Vol. 9, No. 5 (October, 1973), pp. 976-984.

MCGUIRE, WILLIAM J. "The Nature of Attitudes and Attitude Change", in The Handbook of Social Psychology, Vol. 3, 2nd Edition, ed. Gardner Lindzey and Elliot Aronson. U.S.A.: Addison-Wesley, 1969.

MEYBOOM, P. "Estimates of Groundwater Recharge on the Prairies", in Water Resources of Canada, Symposia Presented to the Royal Society of Canada, ed. Claude E. Dolman. Toronto: University of Toronto Press, 1967. pp. 128-153.

MUNICIPAL INSPECTIONS BRANCH, DEPARTMENT OF MUNICIPAL AFFAIRS. Alberta Municipalities, Urban and Rural, Including the Chief Officials of all Cities, Towns, Villages, Counties, and Municipal Districts. Edmonton: Alberta, Department of Municipal Affairs, 1973, Xerox.

NATIONAL WATER COMMISSION. Water Policies For The Future, Final Report to the President and to the Congress of the United States. Washington, D.C.: U.S. Government Printing Office, June, 1973.

OPPENHEIM, A. N. Questionnaire Design and Attitude Measurement. New York: Basic Books, 1966.

O'RIORDAN, T. Perspectives on Resource Management. London: Pion, 1971.

OSGOOD, CHARLES E. "Attitude Measurement", in Attitude Measurement, ed. Gene F. Summers. Chicago: Rand McNally, 1970.

OVERMAN, MICHAEL. Water: Solutions to a Problem of Supply and Demand. New York: Doubleday, 1969.

PATTERSON, W. L. "Comparison of Elements Affecting Rates in Water and Other Utilities", Journal AWWA, Vol. 57, No. 5 (May, 1965), pp. 554-560.

PITCH, HARVIN. "The Treaty Making Power and the Provinces", in Constitutional Aspects of Water Management, Vol. 1, ed. Dale Gibson, Agassiz Centre of Water Studies. Winnipeg: University of Manitoba, 1968.

PROSHANSKY, HAROLD M., WILLIAM H. ITTELSON, and LEANNE G. RIVLIN, eds. Environmental Psychology: Man and His Physical Setting. Toronto: Holt, Rinehart, and Winston, 1970.

QUINN, FRANK J. Area of Origin Protectionism in Western Waters, Social Science Series #6. Ottawa: Information Canada, 1973.

RUSSELL, CLIFFORD S., DAVID G. AREY and ROBERT W. KATES, Drought and Water Supply, Implications of the Massachusetts Experience for Municipal Planning. Baltimore: Johns Hopkins for Resources for the Future, 1970.

SAARINEN, THOMAS F. Perception of the Drought Hazard on the Great Plains, Department of Geography Research Paper No. 106. Chicago: University of Chicago, 1966.

SAARINEN, THOMAS F. Perception of Environment, Resource Paper No. 5. Washington, D.C.: Association of American Geographers, 1969.

SAARINEN, THOMAS F. "Research approaches and questionnaire design", in Perceptions and Attitudes in Resources Management, Resources Paper No. 2., ed. W. R. Derrick Sewell and Ian Burton. Ottawa: Information Canada, 1971, pp. 13-26.

SCHIFF, ASHLEY. "Outdoor Recreation Values in the Public Decision Process", Natural Resources Journal, Vol. 6 (October, 1966).

SCHIFF, MYRA R. Some Theoretical Aspects of Attitudes and Perception, Natural Hazard Research Working Paper No. 15. Toronto: University of Toronto, 1970.

SCHIFF, MYRA R. "The definition of perceptions and attitudes", in Perceptions and Attitudes in Resource Management, Resource Paper No. 2, ed. W. R. Derrick Sewell and Ian Burton. Ottawa: Information Canada, 1971, pp. 7-12.

SCOTT, WILLIAM A. "Attitude Measurement", in The Handbook of Social Psychology, Vol. 2, 2nd Edition, ed. Gardner Lindzey and Elliot Aronson. U.S.A. Addison-Wesley, 1968.

SELTIZ, C., et al. "Attitude Scaling", in Attitudes, ed. Marie Jahoda and Neil Warren. Great Britain: Penquin Books, 1966, pp. 305-324.

SEWELL, W. R. DERRICK and BLAIR T. BOWER, ed. *Forecasting the Demands for Water*, Policy and Planning Branch, Department of Energy, Mines, and Resources. Ottawa: Queen's Printer, 1968.

SEWELL, W. R. DERRICK, and IAN BURTON, eds. *Perceptions and Attitudes in Resources Management*, Resource Paper No. 2. Ottawa: Information Canada, 1971.

SEWELL, W. R. DERRICK "Environmental Perceptions and Attitudes of Engineers and Public Health Officials", *Environment and Behaviour*, Vol. 3, No. 1, (March, 1971), pp. 23-59.

SEWELL, W. R. DERRICK, RICHARD W. JUDY, and LIONEL OUELLET. *Water Management Research: Social Science Priorities*. Ottawa: Queen's Printer, 1969.

SHAFER, EDWARD L. "Perception of Natural Environments", *Environment and Behaviour*, (June, 1969).

SIEGEL, SIDNEY. *Nonparametric Statistics for the Behavioural Sciences*. Toronto: McGraw-Hill, 1956.

SILBERMAN, EDWARD. "The Engineer's Role in Water Resources Planning", *Water Resources Bulletin*, Vol. 5, No. 1 (March, 1969), pp 47-52.

SPAFFORD, D. S. "Water Use Valuation and Pricing Policies", in *Water Workshop Seminar*, Background Papers. Victoria, B.C.: Canadian Council of Resource Ministers, December, 1968, pp. 85-90.

TAJFEL, HENRI. "Social and Cultural Factors in Perception", in *The Handbook of Social Psychology*, Vol. 3, 2nd Edition, ed. Gardner Lindzey and Elliot Aronson. U.S.A.: Addison-Wesley, 1969, pp. 315-394.

TURNOVSKY, STEPHEN J. "The Demand for Water: Some Empirical Evidence On Consumers' Response to a Commodity Uncertain in Supply". *Water Resources Research Journal*, Vol. 5, No. 2 (April, 1969), pp. 350-361.

TURVEY, RALPH. "Side Effects of Resource Use", in *Environmental Quality in a Growing Economy*, ed. Henry Jarrett. Baltimore: Johns Hopkins, for Resources for the Future, 1966, pp. 47-60.

UPSHAW, S. "Attitude Measurement", in *Methodology in Social Research*, ed. Hubert M. Blalock, Jr., and Ann B. Blalock. Toronto: McGraw-Hill, 1968, pp. 60-111.

WALKER, WYNN R., and GAYLORD V. SKOGERBOE. "The Impact of Water Quality Objectives on Urban Water Supply

Planning", *Water Resources Bulletin*, Vol. 9, No. 5 (October, 1973), pp. 861-873.

WARD, EDWARD N. *Residential Water Use in the Hardisty District, Edmonton, Alberta*. Edmonton, Alberta: *Unpublished Masters Thesis*, Department of Geography, University of Alberta, 1971.

WHITE, GILBERT F. "Formation and Role of Public Attitudes", in *Environmental Quality in a Growing Economy*, ed. Henry Jarrett. Baltimore: Johns Hopkins for Resources for the Future, 1966, pp. 105-127.

WHITE, GILBERT F. *Human Adjustments to Floods*, *Department of Geography Research Paper No. 29*. Chicago: University of Chicago, 1946.

WHITE, GILBERT F. "The Choice of Use in Resource Management", *Natural Resources Journal*, Vol. 1 (1961), pp. 23-40.

WOLFF, J. B. "Peak Demands in Residential Areas", *Journal AWWA*, (October, 1961).

WOLLMAN, NATHANIEL, and GILBERT W. BONEM. *The Outlook for Water: Quality, Quantity, and National Growth*. Baltimore: Johns Hopkins for Resources for the Future, 1971.

WOLLMAN, NATHANIEL, *et al*. *The Value of Water in Alternative Uses*. New Mexico: University of New Mexico, 1962.

WONG, SHUE TUCK. *Perception of Choice and Factors Affecting Industrial Water Supply Decisions in Northern Illinois*, Department of Geography Research Paper No. 117. Chicago: University of Chicago, 1969.

WRIGHT, JOHN K. "Terrae Incognitae: The Place of Imagination in Geography", *Annals AAG*, Vol. 37 (1947), pp. 1-15.

ZAJONC, R. B. "Balance, Congruity, and Dissonance", in *Attitudes*, ed. Marie Jahoda and Neil Warren. Great Britain: Penguin Books, 1966, pp. 261-277.

ZIMMERMAN, MARTIN. "Inter-Provincial Water Use Law in Canada: Suggestions and Comparisons", in *Constitutional Aspects of Water Management*, Vol. II, ed. Dale Gibson. Manitoba: University of Manitoba, Agassiz Centre for Water Studies, 1969.

APPENDIX A

QUESTIONNAIRE ON RESIDENTIAL
WATER IN ALBERTA

DEPARTMENT OF GEOGRAPHY
TELEPHONE (403) 432-3274

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA T6G 2H4

July 10, 1973

Dear Sir/Madam:

Accompanying this letter is a questionnaire pertaining to your residential water supply system. This questionnaire is being circulated to all communities in Alberta in hope of gaining a clear and up-todate picture of two things. First, the completed questionnaires should provide an inventory of the characteristics of water supply systems throughout Alberta. Second, it is hoped that the responses will indicate what those people who are directly responsible for managing water supply systems think about some of the problems which are either facing them now, or may face them in the future. The aim of the research project then, is to contribute to a clearer understanding of the factors underlying the growth of demand for residential water. This in turn, would be useful for forecasting future demands for water.

Therefore, may I ask you to please fill out and return the questionnaire to me at your earliest convenience. Your response is significant to me in that I am doing the study to fulfill the requirements for my M.A. degree at the University of Alberta. However, it is also of interest to some members of the Alberta Department of the Environment, (please see the following letter). It is through this department that you may eventually benefit from both your own response to the questionnaire, as well as from the response of others. Perhaps I should note that I realize that you have responded to many such questionnaires in recent years. However, I am aware of these studies and have tried to duplicate them as little as possible, except where more up-to-date information will be of value.

Since this questionnaire is concerned not only with facts, but also with your own ideas, I would very much appreciate it if you as secretary treasurer (or municipal secretary) would fill it in personally. Of course, if after looking the questionnaire over, you believe someone else in the water department is more qualified to answer it, please do pass it on.

I sincerely hope you find that completing the questionnaire is both an enjoyable and worthwhile experience. Please note that an already stamped and self-addressed envelope has been included for your convenience in returning it. If you have any questions, please feel free to contact me.

Many thanks.

Yours truly,

Tom Fletcher

Community of: ________________

QUESTIONNAIRE ON RESIDENTIAL WATER IN ALBERTA

IMPORTANT; PLEASE READ:

Please note that this questionnaire is concerned only with residential water supply. That is, the supplying of water for use in and around the home. Most of the questions have a series of answers provided, of which you may check off one. This type of question is used only for your convenience, since it reduces the time needed to fill in the questionnaire. However, if you wish to write in explanations or comments anywhere, please do so, they will be very much appreciated.

Finally, this questionnaire is not as long as it looks! Read the instructions as you go and you will find that parts of many questions will not apply to you, particularly in the first half of the questionnaire. These sub-questions are differentiated by being lettered (a), (b), (c), and so on, rather than being numbered.

SECTION I

1. First of all then, what is the source of your water supply?

☐ purchased from another municipality
☐ ground water
☐ river or creek
☐ lake or pond
☐ dugout
☐ other (please specify) ______________________

2. How would you describe the initial quality of your water supply before treatment?

☐ very good, treatment not necessary
☐ good
☐ fair
☐ poor
☐ very poor
Please explain any deficiencies: ____________
____

3. Approximately how many domestic consumers (households) do you provide with water? ______________________________

4. Would you please record below (or include a copy of) the monthly pumpage totals for residential water use since January 1971. If your records do not differentiate between industrial and residential, please record the information which you do have and indicate whether or not the figures include industrial water.

☐ includes residential and industrial
☐ residential only

1971	J	________	M	________	S	________
	F	________	J	________	O	________
	M	________	J	________	N	________
	A	________	A	________	D	________

1972	J	________	J	________	1973	J	________
	F	________	A	________		F	________
	M	________	S	________		M	________
	A	________	O	________		A	________
	M	________	N	________		M	________
	J	________	D	________			

These measurements are in ☐ gallons ☐ cubic feet

5. What was the maximum pumpage for one day in 1971?

amount: ________________

date: ________________

☐ information not available

6. What was the maximum pumpage for one day in 1972?

amount: ________________

date: ________________

☐ information not available

7. What is the present maximum day capacity of the system?

amount: ________________

☐ information not available

8. Approximately what percentage of the water you pump each day is lost due to leakage in the mains?

amount: ________________

☐ unknown

9. What sort of storage capacity do you have in the system?

☐ no storage, other than in lines

☐ tanks

☐ reservoirs (in the form of open ponds, lakes, etc.)

10. Has your community suffered any water shortages in the past 5 years?

YES ☐

NO ☐

If YES, please complete parts (a) to (c). If NO, please continue on to question 11.

(a) What was the shortage caused by?

☐ an actual shortage of water

☐ inability of plant facilities to meet demand

☐ other (please specify) ________________

(b) In what part of the year did the shortage occur?

☐ during the summer

☐ during the winter

☐ other (please specify) ________________

(c) How long did the shortage last?

☐ over a large part of the summer (or winter)

☐ peak day

☐ peak hour

☐ other (please specify) ________________

11. Do you foresee any future shortages of water?

YES ☐

NO ☐

(a) If YES, what do you think will be the cause of these shortages?

☐ actual water shortage

☐ limitation of plant facilities

☐ other (please specify) ________________

12. Does fire reserve cause any problems in your community?

☐ NO

☐ YES (please explain) ____________________________

____

13. Have any demand projections been made for water consumption in your community?

YES ☐
NO ☐

If YES, please answer questions (a) to (d). If NO, go on to question 14.

(a) What type of projection was made (i.e. was it a straight-line projection from past demands, etc.)?

____
____
____

(b) Does the projection account for area economic forecasts?

YES ☐
NO ☐
UNCERTAIN ☐

(c) Does the projection account for industrial potential?

YES ☐
NO ☐
UNCERTAIN ☐

(d) Does the projection account for future population projections?

YES ☐
NO ☐
UNCERTAIN ☐

14. Have there been any expansions in your water supply system (other than extension of services) in the past 5 years?

YES ☐
NO ☐

If YES, would you please complete the following questions. If NO, please go on to question 15.

(a) When did the expansion take place? ____________

(b) What was the nature of the expansion?

☐ increased treatment capacity
☐ developed new sources of water
☐ more pumps
☐ metering of homes
☐ storage facilities
☐ other (please specify) ____________________

(c) What was the size of any capacity increases?

____

(d) Did this provide excess capacity and, if so, approximately how much?

☐ NO
☐ YES, amount: ________________________________

(e) When the expansion was planned, did you do a study of alternatives to see which was the most economical means of meeting the demand?

YES ☐
NO ☐

(f) If the study of alternatives was done, what were the alternatives studied and, if possible, would you please give a rough comparison of costs?

alternatives	costs

15. Are there any plans for expansion of your water supply facilities in the near future?

YES ☐
NO ☐

If YES, please do questions (a) to (c). If NO, go on to question 16.

(a) What type of expansion is being planned?

☐ increased treatment capacity
☐ development of new sources
☐ more pumps
☐ storage facilities
☐ metering of homes
☐ other (please specify)

(b) If a capacity expansion is planned, has a study been done to determine the costs of various alternatives?

YES ☐
NO ☐

(c) If a study of alternatives has been done, what were the alternatives studied, and if possible, would you please give a rough comparison of costs?

alternatives	costs
______________	______________
______________	______________
______________	______________
______________	______________
______________	______________

16. How would you judge the ability of your community to pay, through higher water rates, for an expanded water supply system?

very able ☐
able ☐
undecided ☐

not very able ☐
not at all able ☐

17. (a) Did your water department suffer a loss or make a profit last year and approximately how much?

☐ Profit of ______________
☐ Loss of ________________
☐ Broke even

(b) Have there been any recent increases or decreases in the price of residential water?

☐ YES, increases
☐ YES, decreases
☐ NO

If YES, why? ____

18. What type of pricing schedule do you presently use?

☐ flat rate
☐ declining block rate
☐ increasing block rate
☐ constant rate
☐ other (please specify) ______________________

IMPORTANT: Would you please enclose a copy of your pricing schedule.

19. Why is this type of schedule used?

____
____
____
____

20. Do you feel the pricing system could be improved upon, and if so, how?

____
____

____

____

21. Could you give a rough estimate of the average domestic water bill in your community?

amount: ________________

22. Are sewage charges included in the water bill?

YES ☐
NO ☐

23. Is the sewage department part of the water supply department?

YES ☐
NO ☐

24. (a) Do you sell water to any other communities?

☐ YES, to: ________________
☐ NO

(b) Do you purchase water from any other community?

☐ YES, from: ______________
☐ NO

25. To what extent is metering employed in your community?

☐ isn't used at all
☐ commercial and industrial customers only
☐ residential customers only
☐ everyone is metered
☐ other (please specify) __________________________

26. Are your pumps metered?

YES ☐
NO ☐

27. Have you found it necessary to implement water rationing since January 1969?

YES ☐

NO ☐

If YES, please answer the following questions.
If NO, go on to question 28.

(a) Could you describe how rationing was implemented, i.e., what method of rationing was used.

____

____

____

____

(b) How often have you had to implement rationing and in what part of the year?

____

____

____

____

(c) During water shortages, have you tried "exhortation" as a means of reducing consumption, such as asking people not to water their lawns or telling them how much water is necessary?

YES ☐

NO ☐

If YES, how did you go about it and was it effective?

____

____

____

____

28. Is there an active program on the part of the "water department" to detect and repair leaks in any of the following situations (please check those which apply and explain briefly how it works):

- ☐ your own water mains?
- ☐ private water facilities?
- ☐ both of the above?
- ☐ no leak detection program?

29. Has the "water department" employed any engineering consultants to give advice on water problems in the past 5 years?

YES ☐

NO ☐

If YES, please answer questions (a) to (g). If NO, please go on to the second half of the questionnaire.

(a) What year was the firm employed? ____________

(b) What was the name of the firm? ____________

____

(c) Can you remember the name of the engineer(s) who did the study? ____________________

(d) What city is their office in? ____________

(e) Could you please describe what sort of study you had them do for you (example, find more water; feasibility studies of getting more water, etc.)? ____________________

____

____

____

____

____

____

(f) What advice did they give? ____________

____

(g) To what degree was the advice followed?

SECTION II

Thank you for bearing with me so far. This section of the questionnaire is concerned largely with your own opinions, as they relate to various issues in residential water supply. You will also find it less time consuming than the first half.

Please answer all questions in this section.

30. Generally speaking, what priority would you say the provision of residential water takes in your community (when competing for funds with such things as roads, parks, recreational facilities, and so on)?

    ☐ takes highest priority
    ☐ fairly high priority
    ☐ low priority
    ☐ very low priority
    ☐ equal priority with ______________________________

31. Different people have different ideas as to how much should be charged for residential water. What would you say is the best "rule of thumb" on which to base the price of water?

    ☐ charge enough to cover the costs of delivery and system maintenance only

    ☐ charge enough to cover the costs of delivery and maintenance, plus build up some capital for future expansion

    ☐ charge enough to cover all of the above, plus make a small profit

    ☐ charge a high enough rate to cover all of the above, as well as discourage people from using too much water

    ☐ other (please specify) ___________________________

    ____

32. The following table contains several statements which might be made in connection with the supplying of water to residential customers. Please read them carefully and indicate by checking the appropriate box how strongly you agree or disagree with each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Generally, it might be said that most people do not waste water.					
It is best to supply all the water demanded by people, irrespective of the difficulties of providing it.					
It is unlikely that most people overuse water in and around their homes.					
People should pay more for water which they use irrigate their lawns.					
People have a right to all the water they want.					
Everyone should be allowed a certain standard minimum quantity of water to cover basic needs and people who use more than that should pay more for each unit of water above that minimum.					
Most people would be quite willing to pay more for extra units of water if they had to.					

Even if they are willing to pay more, people should only be allowed to use a certain amount of water to irrigate their lawns.					
People should have to pay more for water which they use to wash their car(s).					
People should have to pay more for water which they use to fill their swimming pool.					

33. Some resource management people claim that when the consumption of residential water is increasing, it is possible to slow down this increase or even reduce the level of consumption by using various techniques. They see this as an alternative to increasing the supply of water to meet the growing demand.

Even if this is possible, would you agree or disagree that it is right to restrict a person's consumption of water? (Please qualify your answer if you wish).

strongly agree ☐
agree ☐
undecided ☐
disagree ☐
strongly disagree ☐

____

____

____

34. If, for the sake of argument, it was decided that consumption should be reduced, one of the means put forth to restrict or reduce demand is metering. How effective do you feel meters would be in reducing consumption, particularly after they have just been installed? (Please answer whether your community is metered or not.)

very effective ☐
effective ☐
undecided ☐
ineffective ☐
very ineffective ☐

35. If the consumption of water per household was reduced by metering initially, do you feel it would return to normal after the meters had been installed a year or two?

YES ☐
NO ☐
UNDECIDED ☐

36. If a community already had metering, how effective do you feel raising the price of water would be in reducing demand?

very effective ☐
effective ☐
undecided ☐
ineffective ☐
very ineffective ☐

37. Again, for the sake of argument, if consumption per household was reduced by higher prices, do you think it would stay down over a period of time?

YES ☐
NO ☐
UNDECIDED ☐

38. Have you ever raised the price of water in your community with the intention of reducing consumption?

YES ☐
NO ☐

39. What do you think other agencies or water management people think about trying to conserve water by raising prices?

- ☐ most of them think it is a good idea
- ☐ most of them think it is a poor idea, because it won't work
- ☐ most of them don't worry about it, because they don't see any need to conserve water
- ☐ other (please specify) ____________________

____

40. How effective would you consider rationing to be as a means of reducing consumption?

very effective ☐
effective ☐
undecided ☐
ineffective ☐
very ineffective ☐

41. Do you consider rationing acceptable as a means of reducing water use for a short period of time?

YES ☐
MAYBE YES ☐
NO ☐
UNDECIDED ☐

42. Do you think rationing procedures would be acceptable as a means of reducing consumption over a long period of time?

YES ☐
MAYBE YES ☐
NO ☐
UNDECIDED ☐

43. How effective do you think that asking people to cut down on their water consumption voluntarily by not watering their lawns, washing their cars, etc., would be over a short period of time?

very effective ☐
effective ☐
undecided ☐
ineffective ☐
very ineffective ☐

44. The following table contains several more statements which might be directed to you, as a water manager. Please indicate how strongly you agree or disagree with each statement by checking the appropriate box.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The public expects unlimited supplies of water.					
The public expects to receive water at only a nominal price, such as that price which covers the cost of delivery only.					
People are willing to pay higher prices to continue receiving unlimited supplies of water.					
People should be able to expect enough water to keep their lawns green in summer.					
The public expects the water department to encourage the conservation of water.					

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
If you could reduce the consumption of water, you could reduce sewage treatment costs significantly.					
If you could reduce the consumption of water per household, you could reduce the costs of supplying the water.					
Using as little water as possible is a worthwhile goal for any water department.					
There is no need to conserve water, at least in Alberta, because there is plenty of water for everybody.					
If it were every to become necessary to conserve water, the leadership for such a program should come from the provincial government.					

45. Who makes the final decisions on expansion of plant facilities, finding new sources of water, and so on, in your community?

☐ yourself
☐ town (city) council
☐ other (Please specify) ______________________________

46. Who makes the final decision on what price is charged for water in your community?

- ☐ yourself
- ☐ town (city) council
- ☐ other (please specify)

47. If you do not make the decisions, how much influence would you say you had upon any decisions affecting residential water supply in your community? (Please do not be modest?)

- ☐ no influence
- ☐ some influence
- ☐ a great deal of influence

48. If you do have some influence on decisions, would you please describe how; that is, whether it is by making recommendations as to the best solution to a problem, what price should be charged for water, and so on.

____

____

____

49. How much influence would you say the provincial government agencies have on the quality of service officered by your water department?

- ☐ no influence
- ☐ some influence
- ☐ a great deal of influence

50. What types of assistance does the provincial government offer your water department now? (Please note the department or branch involved).

____

____

____

____

____

51. Would your water department welcome more assistance from the provincial government, other than financial, to help manage your water supply?

YES ☐

NO ☐

If YES, what type of assistance would you like?

____

____

____

____

52. In what ways do you see consulting firms as important to residential water management, if any?

____

____

____

____

53. How qualified do you feel most consulting firms are to do work on residential water supply problems (as compared to government agencies, say)?

____

____

____

____

____

SECTION III

By way of conclusion, I would like to ask you a few questions about yourself. These questions are of a personal nature, so if you are unwilling to answer them, please complete the rest of the questionnaire and forward it to me. You may remain assured though, that this information will be kept completely confidential.

54. How many years have you worked at this particular job?

____________ years.

55. How many years have you lived in your community?

____________years.

56. Which of the following educational categories would you place yourself in?

- ☐ 8th grade or less
- ☐ grades 9 - 12
- ☐ 1 - 3 years of university
- ☐ university graduate
- ☐ technical or vocational school
- ☐ other (please specify)

57. Have you had any formal training specifically related to water management?

YES ☐

NO ☐

If YES, would you please describe what kind?

____

____

58. If other than the person to whom this questionnaire was addressed, would you please give your name and position title.

____

59. If you have any comments or additional information which you would like to add, please do so below. And please don't forget a copy of your pricing schedule.

Thank You Very Much For Both Your Time And Cooperation.

APPENDIX B

COMMUNITIES WHICH HAVE SUFFERED SHORTAGES IN THE PAST FIVE YEARS

Cities

Grande Prairie
Lethbridge
Lloydminster
Medicine Hat
Red Deer

Towns

Barrhead
Blairmore
Calmar
Claresholm
Devon
Drayton Valley
Eckville
Edson
Fairview
Fox Creek
Killam
Manning
Milk River
Raymond
Redcliff
Redwater
Rocky Mountain House
Smoky Lake
Spruce Grove
St. Albert
Stavely
Stettler
Stony Plain
Three Hills
Tofield
Vauxhall
Viking
Vulcan
Wainwright

Villages

Arrowwood
Barons
Bellevue
Blackfalds
Bowden
Carmangay
Cayley
Champion
Chauvin
Clyde
Coutts
Cremona
Delia
Duchess
Donalda
Entwistle
Glenwood
Halkirk
Hillspring
Irma
Kinuso
Linden
Mannville
Vorrin
Myrnam
Nampa
Ryley
Sexsmith
Thorhild
Youngstown

Hamlets

Veinerville
Mossleigh

APPENDIX C

COMMUNITIES WHICH HAVE RATIONED RESIDENTIAL WATER, SINCE JANUARY, 1969[a]

Cities

Grande Prairie	
Lethbridge	
Lloydminster	
Medicine Hat	X
Red Deer	

Towns

Beaverlodge	X
Black Diamond	X
Calmar	X
Claresholm	X
Drayton Valley	
Eckville	
Edson	
Fairview	X
Fort Macleod	X
Fort McMurray	
Fort Saskatchewan	X
Killam	X
Milk River	X
Raymond	X
Raymond	X
Redcliff	X
Rimbey	
Spruce Grove	
Stavely	
Stony Plain	X
Three Hills	X
Tofield	X
Vauxhall	X
Viking	X
Vulcan	X

Villages

Barons	
Bellevue	
Blackfalds	
Bon Accord	
Bowden	X
Cayley	
Coutts	X
Crossfield	
Duchess	
Edgerton	
Glenwood	
Irma	X
Linden	X
Morrin	X
Myranam	X
Sexmith	
Thorhild	X

Hamlets

Mossleigh	
Sherwood Park	X
Veinerville	X

---

[a] Those which also rationed from 1963-1968 are marked with an "X".